Aalto University
School of Science
Master's Programme in Service Design and Engineering

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ICT Enabled Business Model to Modern China Elderly-care Service

Master's Thesis

Espoo, November 25, 2015

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Aalto University
School of Science

Aalto University School of Science Degree Programme in Computer Science and Engineering Master's Programme in Service Design and Engineering	ABSTRACT OF THE MASTER'S THESIS

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Title: **ICT Enable Business Model to Modern China Elderly-care Service**

Number of pages: 60	Date: 25th November,2015	Language: English
Professorship: **Prof. Martti Mäntylä**	Code: **T-86.Martti**	

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Abstract:

The aging population was becoming an unavoidable global problem especially in the largest developing country, China in past 20 years. Apparently the traditional elderly-care approach has been being lowly productive and leading more and more social problems by time. But in the other hand, it is a great opportunity to the modern elderly-care business vendors world-widely to introducing new innovative ICT enabled elderly-care services. To understand the true demands in the market and identify a business model enabled by ICT approaches are important to the industry and society. In this paper, the research work aims at the home elderly-care mode which is currently the major one in China and to identify the key demands of elderly-care service locating at the daily supports to the elderly's safety and health issues with low costs by ICT approaches and creation of new connections between the elderly and their family. To resolve the above concerns, the architecture design of business model by framework of business modeling Canvas was implemented and a piloting project which was applying the ICT enabled business model was carried out in two Chinese cities Wuhan and Zhongshan to verify the feasibility of work. As result of the piloting projects, it demonstrated that the ICT enabled elderly-service was a feasible and productive way to solve the aging problem in China society. But besides to satisfy the safety and health requirements of elderly users and their family, it is also important to collaborate with the public sectors, 3rd party service providers and telecom operators to establish an ecosystem for elderly-care industry. The ICT enabled business model to modern elderly-care service is a developing subject and the business model and piloting project introduced in the paper would be a useful attempt which may lead to the innovative solution of aging problem.

Keywords: Aging problem, Business model of elderly-care service, Information management platform, ICT methods, Case study

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1. Introduction

Aging population is becoming a global problem due to the baby doom after the 2nd world war. Internationally the common standard to determine an aging society is to calculate the proportion of elderly population age over 65 years old accounts for upper than 10% of the total population in a country or region, which means this country or region has entered the aging society. [63] Most of European countries especially Nordic countries have been aging areas for almost 2 decades because of the higher wealthy level and longer average length of life in the worldwide. Meanwhile, to reduce the negative impacts of that aging problem, the Nordic countries have invested plenty of resources in social well-being and elderly-care service which consists of concepts researches, technology development and modern elderly-care methodology modelling.

On the other side of the world, China as a developing country which is considered to be largest prospective aging market in the world, is rapidly increasing in life expectancy of Chinese population and the decades of decline in Chinese birth rate. Up to 2012, China has become one of the countries, which have largest elderly population in the world before it becomes largest economic entity. In 2012, the Chinese elderly population aged 60 has increased to approximate 160 million which accounts for 13% of the total Chinese population, and the average annual increase rate of Chinese aging population is 3.2%. According to Unite Nation statics, the Chinese elderly population aged 80 will reach to 100 million in 2050, which is accounting for one fifth total elderly population in the world. [7] [59]Although the Chinese economy and aging population are increasing promptly, the China society is still unable to take any effective solutions timely for resolving such aging problem due to the large population base and its complex social condition. Averagely, China is still a developing country. Therefore, the stress to serve Chinese social elderly-care problem is much greater than the other more advanced areas in the world. If it is available to apply Nordic elderly-care concepts and technologies to resolve China problem, and once solutions for aging population could be approved successful in China, it could be applicable to larger areas in the world, which helps the other countries facing the challenge of aging population and meanwhile creating millions of opportunities for Nordic vendors.

For the above reason, an international joint research project called “active aging” was initialed since 2010 Shanghai Expo by Finnish and Chinese academic organizations,

governmental sectors and commercial entities. The objectives are to study the practical demands of China elderly-care market, to analyze the relationship between market needs and existing elderly-care solutions in both Finland and China, to identify the China modern elderly-care business model. And to facilitate the project, a Chinese startup company named Wuxin aiming at developing a business model that supported by an information platform as a solution which collects, integrates and distributes data of elderly users from different sensor based devices and services, to improve the efficiency of elderly-care work and quality of people's life was established in 2011 for better connecting the china market to Finnish solutions. In the research, most of Chinese activities were implemented by that company and study cases such as piloting project was initialed under its operation.[3]

In this paper, generally a study of China elderly-care business model and its corresponding information service platform will be presented to the audiences for better understanding of current elderly-care services and ecosystem in China. In Chapter 2, a literature review firstly analyzed the problematic issues and launched a discussion of the most important issues in Chinese elderly-care industry, then the author attempted to introduce a concept of elderly-care information management platform in different market categories of China elderly-care industry. Chapter 3 and 4 discussed the research problem and research methods in the thesis. China elderly-care business models and the design of an elderly-care information management platform to serve such business model for establishing a new elderly-care ecosystem aiming at solving the essential problematic issues of elderly-care industry will be introduced. The research method will be combination of virtual design and practical applications of piloting project in two cities of China which are Wuhan and Zhongshan. The last chapter concluded thesis and also promoted some ideas for the future design of modern Chinese elderly care business model. The objective of this thesis was to study a business model and its information management service platform which can provide ICT related solutions for all roles in the entire Chinese elderly-care ecosystem based on a literature review was proposed.

2. Literature Review

The subchapter of "Issues of home living urban Chinese elderly" aims to list the main issues of urban home living elderly daily life in safety, health and mental well-being. Then to analyse the root causes of these issues. According to the results of issues analysis to find more suitable ICT solutions for Chinese elderly home living people by means of literature research.

2.1 Issues of Chinese elderly in home living

There are many problematic issues in urban Chinese elderly home living environment nowadays, and it is not doubt that safety issues must be put at the first to be resolved. Under the premise to ensure the personal safety for the elderly, then it could consider solutions for other problems such as physical health, intelligence health, mentality happiness and living with better quality.

2.1.1 Safety issues

The main safety issues of urban Chinese elderly daily living life at home includes falls which is most common risk, unexpected emergency issues in fire emergency, flood emergency, gas emergency and the emergency situations with sudden illness, the most dangerous risk for elderly people is when they get lost in outdoors unconsciously. The below three subchapters claim the risk of each issue and the reasons cause these issues.[17]

Falls

Falls are the most common risk in elderly people live at home. The previous western studies have shown that up to one third of community-dwelling older adults will fall every year. Tero, Kiel and Mor reported out the variation between 224 to 809 per 1000 person falls in UK, Finland, New Zealand, United States and Sweden each year after their prospective study in "a risk factor for falls in community-dwelling elderly". The highly urbanize Chinese city Hong Kong livers showed a prevalence rate of falls is 18% in 2004. Even though there has been no previous study and incidence of falls data in Chinese elderly home fall, the falls are still the most risk for elderly people either when they live at community or at their own home. [2]

Due to most of falls do not results in death or serious injury, many of elderly people treat with disapproval of their falls. But there are about 5% of falls cause fractures and more than 10% falls result in brain damage by soft tissue injury or dislocated, so as to reduce the activity of elderly. The Chinese disease surveillance system published their finding of mortality rate in population falls from 2000 to 2005, in the population group over than age of 60, there are 2.303 percent mortality rate for male and 2.604 percentage mortality rate for female by falls. [2]Meanwhile, the hospitalized numbers of elderly people because of falls are 5 times more than other injuries and the hospitalized time takes 2 times longer than the ordinary patient treatment in recovery period. These show the falls in elderly have a serious impact on their health and daily living life. And with comparing the elderly people who do not fall, falls in elderly people group also has a great negative impact on their social activities, spiritual and psychological states. Fall or almost fall may cause fear and impose restrictions on their activities to decline their daily activities, and even lose their confidence to do any regular activities. Thus, falls have become an important factor that affects the physical health, mental health and safety in elderly population.[25]

The urban Chinese elderly people who live at home may face more possibilities to fall. Due to large amount of Chinese population, the urban residents have limited living space. A small living space increases the probability of fall when elderly people live at home. Hong Kong is a typical urbanized city in China, there are 48% of population lives at low-cost high-rise housing consists of small floor areas which provided by Hong Kong government. The reasons of falls also related with various time of day. For example, elderly people are prone to fall in the morning when they get up from bed. Because of people's blood pressure will rise and may cause cardiovascular diseases at this time. The other reason is the activity of muscles and joints may not fully recover and in good condition after 8 hours lay on bed. So it is easy to fall down when elderly people get up in the morning. In addition to the morning, the high incidence of falls for elderly people is at late night when they take urination at night. Moreover, the self-diseases of elderly people are the other one of reasons cause falls at home. For instance, the self-diseases include arthritis, vision problems, dizziness, anemia.

Unexpected emergency

In China, the mortality rate of fire in elderly people group is twice higher than average mortality rate of fire. And the elderly group over than 85 years has about four times than

average mortality rate of fire in China. The fire prevention for the urban Chinese elderly people are becoming very important. [2]

The reasons cause fire can be divided into three parts roughly: physical illness, inappropriate habits and lack of basic fire prevention knowledge. Many elderly people live at home due to their mobility, unresponsive issues and even with other diseases as paralysis and dementia may cause a fire when they are cooking. And once the fire break out, it is difficult to escape the scene quickly for elderly person. The inappropriate habits of Chinese urban elderly is the other reason to cause fire. For example, Chinese people have the habit of smoking at home, the old living style of using stove for heating in the winter time and the elderly also accustomed to burn the mosquito coils for repelling mosquitoes at home in summer time. Some of devout elderly Buddhists burn incense and pray at home. These inappropriate habits are easy to cause fire. Once the fire is coming, the lack of awareness and knowledge of fire prevention may make elderly person become a fire victim.

In addition to the fire threats the health and life for Chinese urban elderly people, as the flood risk at home also threats the life for elderly home livers. In nowadays, most of urban elderly Chinese people's living places are relatively old and with a number of incipient risks as old pipes and roof leak. These factors could cause home flooding. Another common cause of flood in elderly home is the elderly may forget to turn off the water faucet after a bath or using the water. Once the flood is coming, the slippery ground may cause fall and the electrical short-circuit may result in a great threat for elderly people.

Since most of Chinese urban elderly get used to cook and boil tea by using gas stove, which may cause carbon monoxide poisoning if in using gas stove improperly or forget to turn if off after use it.

The elderly people live at home in addition to hedge against fires, floods and gas leaks, it also should prepare for other unexpected emergency situations with sudden illness。For example, due to fatigue, weather change and excitement could increase their cardiac load and result in sudden dizziness, the strenuous exercise will suddenly produce joint pain also. Moreover, when the elderly people who have heart diseases, asthma, arthritis and other diseases who live alone at home may face with great unexpected emergency situation that occur with life-threaten any time.

Lost in outside

In recent years, the term of “empty nesters” is becoming more and more popular. “Empty nesters” is a metaphor of young birds go away and leave the empty nest for their parents. According to statistics in 2004, the “empty nesters” accounted for half of age over than 60 years old in Chinese elderly people. A huge numbers of “empty nesters” exists in varying degrees of psychological anxiety, loneliness and depression and they are eager to go outside and meet with people. However, the major danger of elderly face is to get lost outdoor. [7]

The elderly lost in outdoor has become an increasingly serious social problems in China. In order to find the lost elderly, other family members tend to spend lots of energy and time on it and they also worried about this wandered situation occurs again after the elderly people find. Meanwhile, it brings a heavier workload on the public officers. According to the psychiatrist analysis, the previous lost experience will bring a great psychological trauma for elderly people also, which allows the elderly themselves feel fear every time they go out of home. According to 2008 survey Chinese Union Welfare of Elderly, the amount of missing elderly population accounts for 40% of all missing population. The lost elderly usually face with higher dangers in outdoors. For example, they may not only face with water and food shortage, but also could be walking in inclement weather with the dangers of traffic and accident falls. With the longer time of elderly people lose outside, their morphology probably will change, that increase the difficulties to help elderly get their home.

There are many reasons of elderly get lost in outdoors. One of the major reasons is related with their diseases such as dementia, mental illness, memory loss and poor recognition ability because of their old age. In addition to diseases of themselves, the elderly lose are also affected by external environment. With the accelerated space of construction in Chinese cities, the surrounding of elderly living environment and lifestyle are changing every year. For example, the park in front of elderly living home may become a office building one or two years later. The rapid urbanization of China cause great difficulties and affect the daily life of elderly people.

To keep safety is the major and most important thing for urban Chinese elderly daily living life at home. After ensure that elderly people can protect their own safety, the next

step is to seek several ways of approaching to keep elderly people living longer and better at their home.

2.1.2 Health issues

The basic and common way to keep elderly people living longer is to maintain a good health for elderly adults. However, the most of elderly adults usually have ambiguous definition of “good health” and many of them consider “good health” equal to physical health. This thinking is reasonable but there are many aspects can be judged an elderly whether to meet the “good health” standards. [46]

As early as 1982, the Chinese Medical Association on Gerontology Branch raised 5 standards in “good health” for Chinese elderly people and mainly pointed that the major organs are health of elderly adults and with absences of disease themselves as regards to compliance with health standards. In 2013, the Chinese Medical Association on Gerontology Branch has been revised the previous five standards which based on the new progresses in concept of health from international environment and also combined with the specific circumstances in Chinese elderly living environment. The newest five standards are formulated a “The Chinese Health Elderly Standard in 2013 Edition” which redefined what is “good health” for the Chinese elderly. To better understand those five standards can help Chinese elderly people how to maintain their own health at home and live longer. The health issues of Chinese elderly live at home will be discussed around these five standards.

Disease issues of elderly health

The disease issues in elderly health are generally divided into two types: one type is a serious illness that may cause death in any uncertain time, and the other type is ailment that won’t cause life-threatening.

The first standard in “The Chinese Health Elderly Standards in 2013 Edition” mentioned extent of the diseases is the main criteria for judging whether the elderly people in good health condition. If an elderly adult does not have any serious illness and his or her ailment is in a stable condition, it could meet “a good health” newest standard.[18]

Without serious illness refers to the vital organs such as hear, brain and kidney of elderly people are degrading somewhat due to their increasing age, but it does not lead to dysfunction. The elderly who has history of cancer, cardiovascular and cerebrovascular diseases such as myocardial infarction and stroke also can be counted within serious illness. The ailment in stable condition refers to the minor disease can be controlled after elderly people take medication or change his or her living life. For example, although many Chinese elderly people sick with high blood pressure and diabetes, these diseases can be controlled within a safe range by taking the medication and self-conditioning.

Intelligence issues in elderly health

Having "a good health" is not enough for a Chinese elderly live at home, the elderly people should also have a normal intelligence ability and be able to handle a huge number of trivia in their life, for instance, cooking, laundry, cleaning, entertainment and so on.

The intelligence is a comprehensive concept which composed of attention, observation, imagination, memory, thinking, practical and social adaptability force. With the growth in elderly age, the intelligence of elderly people is also accompanied the recession.

A part of elderly intelligence recession is caused by age-related memory loss and the other part is due to some mental illness. In "The Chinese Health Elderly Standards in 2013 Edition", the second standard strongly suggests the Chinese elderly could simply assess their intelligence by "The Easy Chinese Elderly Intelligence Scale", then scientifically determine whether their intelligence reach the normal level based on the assessment results. For the group of Chinese home living elderly people's assessment results below than normal level, they should be more careful and seek for solutions.

Mentality issues of elderly health

Traditionally, it would have been enough for an elderly adult who with a health body and normal intelligence to handle his or her daily living life at home. The third standard in "The Chinese Health Elderly Standards in 2013 Edition" indicates the mentality issues are becoming a serious problem to affect the health of the Chinese home-living elderly.

The reasons may cause mentality issues in Chinese home-living elderly group as follow: 1. the elderly prefer to stay at home and away from the outside social life after the retirement. With the shrinking life circle of retirees, the opportunity to communicate with

the outside world is gradually reduced from Chinese elderly group, which lead them gradually out of touch with the rapid development of society. This marginalization of social and family situation may easily cause the elderly mental depression. 2. Some childless elderly couples and the elderly families without long-term care by their children will have a strong sense of loneliness. 3. Some frail elderly or someone with mobility reason also reduce the frequency of contact with friends and relatives that could result in intense loneliness for the elderly adults. For the Chinese elderly who have long-term residence at their home alone and are lack of communication with other people will have sad, depression and mental malaises. The immunity of the elderly body will also decrease and result in more diseases while elderly adults with long-term mentality issues. 4. When some of elderly has certain brain diseases or their brain tissue associated with aging, their mood are changing frequently and tend to lose self-control and performance in anger sometimes. The elderly in this state become more difficult to communicate with others. 5. The unexpected changes also the reason serious mentality issues caused in elderly adults group. For instance, lose spouse suddenly, accident falls, not enough money to spend and so on. There are 48% elderly group has depression with economic conditions in urban Chinese elderly people. These unexpected changes will cause long-term mental tension of elderly group. Thus it can be seen the Chinese home living people are susceptible to mental illness. With comparing the health diseases, most of people tend to ignore the dangers of mental illness.

Actually, the mental illness seriously affects the health of the Chinese home-living elderly adults. There are many manifestations of Chinese elderly who suffers from mental illness, of which the most important are the negative emotion, retardation of thinking, loss of willpower and suicidal ideation and behaviour in some serious cases. The mental illnesses also make the elderly people choose some unhealthy living ways that can help get rid of illness and loneliness, such as smoking and drinking. And this unhealthy lifestyle can also lead to cardiovascular disease, diabetes and other chronic diseases.

In “The Chinese Health Elderly Standards in 2013 Edition”, the third standard wish the Chinese home-living elderly people could fully realize their own mental status and pay more attentions on the potential development of social participation. The Chinese elderly could simply assess their mental status by “The Easy Chinese Elderly Geriatric Depression Scale”, and then scientifically determine whether their mental health reach the normal level based on the assessment results.[22]

Living issues in elderly health

The “living habit” was new standard in “The Chinese Health Elderly Standards in 2013 Edition”. This standard pointed out good living habits is the basis to maintain health of the elderly people. The reason why the “living habit” was listed as one of the new Chinese health standards in 2013 was the urban Chinese elderly lifestyle has been tremendous changed in last a couple of years under the fast development of Chinese urban economics, and these changes become the serious problems are afflicting the health of Chinese urban elderly group.[44]

With the income and living standard of Chinese urban elderly improving, their eating habits tend to more meat and junk food compared with their previous eating habits on simple meal that result in an increasing number of Chinese urban elderly people who become obese. There are nearly 40% are overweight or in obese status during the urban Chinese elderly group by investigated from Chinese Elderly Health Association in 2013. However, only 41.27% of all urban Chinese elderly adults regularly participate in physical exercise every day. [13]The unhealthy eating habits lead to high blood pressure, diabetes and other chronic diseases.[11]

There are many urban retried Chinese elderly people with nothing to do every day and have to pass the time on watching TV or playing mah-jong. This bad sedentary habit seriously affect their digestive function and likely to cause indigestion, constipation, haemorrhoids and other diseases. Some of urban Chinese elderly used to choose play cards and mah-jong outdoor, it also easily leads to poor blood circulation to lower limbs and may aggravate knee degeneration when the outdoor temperature is low.

In addition, smoking and drinking habits also have become a serious factor that affects the health of elderly. The Chinese Elderly Health Association pointed out there is nearly 30% of male urban Chinese elderly have habit on smoking in 2013. The elderly smokers significantly increase the incidence rates of heart disease, hypertension, cerebrovascular disease and peripheral vascular diseases. If an elderly person suffering from both smoking and high blood pressure, the stroke risk will rise nearly 20 times than others. In addition, the smokers are susceptible to arteriosclerosis obliterans and occlusive thrombus arthritis. The drinking culture in China for thousands of years and many Chinese elderly people

has the habit of drinking. A small amount of alcohol can promote the blood circulation of human body which can help people stay healthy. The elderly people who have cardiovascular, liver, stomach, duodenum and other organs diseases should try to reduce the amount of alcohol, especially it must prohibit the alcohol for the elderly who is taking the medication, or otherwise the alcohol will reduce the effectiveness of medicines.

Self-care issues of elderly health

In "The Chinese Health Elderly Standards in 2013 Edition", the self-care ability belongs to the fifth standard to judge whether an urban Chinese person in a good health condition.

Self-care ability usually refers to activities of daily living (activity of daily living ADL) and functional activities of daily living instrumental activities of daily living IADL). ADL is the basic self-care ability of elderly people to engage themselves into their daily life activities, such as wear and wash clothing, cook and eat food, use transportation and keep personal hygiene. ADL is the basic need for a human being. IADL means of the level whether an elderly can live independently and living with quality life. For example, walk independently, do some sports, use transport by themselves. [2]

In December of 2000, the Chinese Aging Research Centre survey of 20,000 elderly people who over than 60 years old in 20 provinces of China. After the self-care ability (ADL and IADL) test, it showed there were 5.2% urban Chinese elderly and 8.9% who live in rural areas cannot take care of themselves. And these proportions are greatly increased in the past ten years. Resulting in the increasing number of urban Chinese elderly cannot take care of themselves because the Chinese family structure has been changed. In the traditional Chinese family during the past time, the children have obligations to take care their parents. Due to the imbalance development of Chinese different cities, there are more and more young people choose to live in a few big tier one cities. However, their parents have to stay at their own home and lack of help from their children. Accompanied by the popularity of Chinese"one child" policy, the number of young people are reducing and the elderly people are increasing. There will be more and more elderly people cannot be took care by their children in the nearly future. These "empty nesters" who are not properly cared would face more risk of disease so as to lose their ability to take care themselves.

2.2 Elderly-care modes

2.2.1 Introduction to China elderly-care business categories

In China elderly-care industry, there are 3 types of business categories, the home elderly-care, institutional elderly-care and elderly-care real estate. The home elderly-care mode is the most traditional approach in China social elderly-care system due to the Chinese culture of family support for thousands of years. The family relatives take care of the elderly's living and the elderly will enjoy their life-time at home. Presently, there are about 180 million people elder than 60 years in China and over 90% of them living at home.[33]

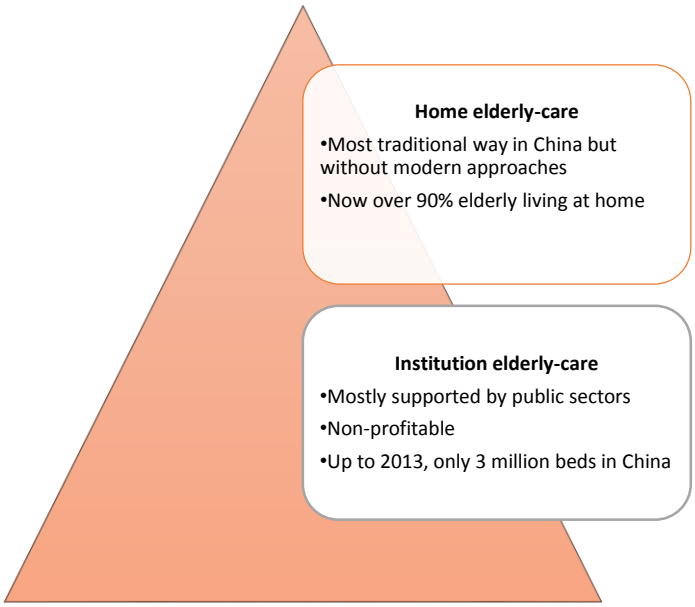

Figure 1: Elderly-care business categories in China

But situation is changing, as the one child policy is advocated in China mainland since 1980s. The family mode turns to 4+2+1 type which means that 4 elderly+2 middle age couple+1 child. The family members will not be able to support the elderly at home anymore. So since 2000, the China government started to facilitate the elderly-care institutes system and tried to turn minds of people from family elderly-care to institutional elderly-care which is the second business category in China elderly-care industry. But

due to the characteristics of Chinese elderly-care culture, most of the customers in institutional elderly-care are less income class. So most of institutes are not profitable and less private capital would like to invest into that area. As a result, the government and charity organizations are the major supporter of that business. But the public resource being invested into that area is very limited, which turns out that the number of institute's volume can only cover 1.14% of entire elderly-care population in China till 2012.[59]

To resolve the aging challenge the above two business categories may have their own defects. So another new business category is generated by the combination of real estate business and elderly-care industry, which is named elderly-care real estate. The concept consists of escort travelling, care service, housing and financial investment. A typical model is to develop several real-estate projects with supports of care services in different areas which could be classified by specific features but all attractive to customers. For instance, one housing project will locate at escort besides sea in warm climate and another could stand in the city downtown where enables the customers to enjoy modern life. Customers could subjectively select living area according to individual interests or different seasons. The real-estate is not sold to customer, owner of all estates is the developer or operator of such project. The customer need to pay membership fees, usually for 10 years, once to be able living in such projects. The membership fee acts as a pool of funding as well, every year a common interests of that membership fee will be returned to customer and if in case the customer can not spend the time length of membership, the redundant membership fees will be returned to customers. Because of the particular policy in China for elderly-care industry, such kind of real-estate elderly-care projects typically could have fully supports from China state owned financial entities while the ownership of the real-estate belongs to the elderly-care service operators. It makes the service operators easier to collect fixed investments back in a short period by loans from banks and maintain a health financial status to emphasize on the elderly-care service. In the past 15 years pricing of China real-estate has increased 10 times and there is an optimistic vision on next decade or even longer term. So even if the elderly-care service is non-profitable, such elderly-care concept was recognized and advocated by many commercial entities. It has been initialed for a few years and plenty of capitals have been involved into that business. The market volume of that business is estimated over 5 trillion RMB in 2020. Prospects of that industry are very potential, but meanwhile the challenges need to be resolved in that business category such as elderly-care information management and

optimization of service resources distribution are seriously. Service platform would be an important topic for such concept.

2.2.2 Platform for elderly-care

The platform serves in elderly-care industry will be an integration of commercial and technical layers. Technically, it can be a concrete information platform to manage data and logics for daily operations, which will be introduced in the latter chapter. Conceptually, the platform presents the eco-system in elderly-care industry. There are different stakes and roles in the system, each of them will have its own weights and cross effects on the other ones.

In home elderly-care business, there are stake holders of users, service providers, buyers, technology providers, and public sectors. The users could be the elderly and their relatives, who are enjoying the services from service providers such as community, daily assistance agency, community health center or hospital, restaurant, shopping mediator and so on. The service providers would need support from technology providers by their elderly-care products like sensor devices. Most of expenses in the system usually is afforded by the users themselves or their family relatives. But in some extremely cases, the activities could be sponsored by public sectors like local civil affair offices or charity organizations. Especially for the “empty nesters” or the elderly with low income. Meanwhile, in most cases public sectors are able to access the information of each roles in the platform, which could be understood as to manage the social well-being services by real-time data. The technical elderly-care platform will support the processing and management activities of above roles.

In the institutional elderly-care mode, the institute will customize the information management platform and elderly-care sensor devices to serve the residents. The expenses will be charged from customers and governmental sponsors.

The elderly-care real estate business may be different from the above two modes. The real estate developer and operator could be service provider or outsource a third party as service source. A customized elderly-care solution which includes information management platform and user-end devices will support the services. The major business for developers and operators would be the financial services rather than elderly-care itself.

When the customers are buying or renting the houses, the elderly-care services will be considered as add-on value to the customers.

2.3 Business model canvas

Business model canvas will be applied as a tool to present and visualize the business structures. This approach is a strategic management template for developing new or documenting existing business models and it could help readers to catch the details of each building block and to understand the overview of business model in the same time.

There are nine building blocks in the business model canvas as below figure illustrating: Customer segments, Value proposition, Channels, Customer Relationships, Key activities, Key resources, Key partners, Cost structure, Revenue streams.[64]

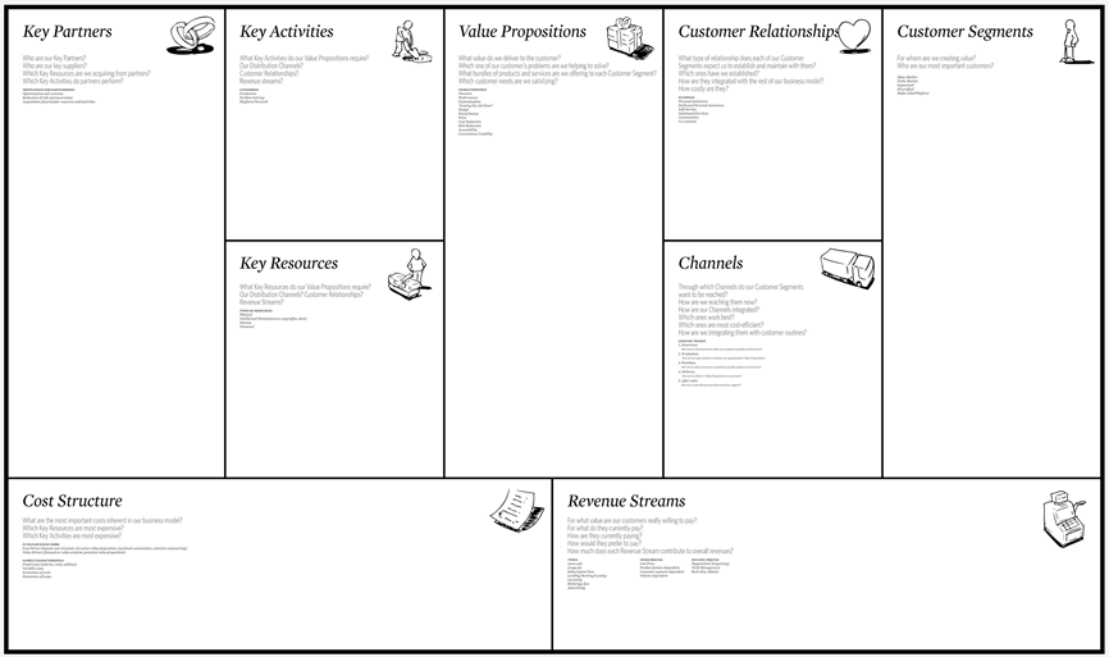

Figure: Business model canvas

Customer Segments: To build an effective business model, a company must identify which customers it tries to serve. Various set of customers can be segmented based on the different needs and attributes to ensure appropriate implementation of corporate strategy meets the characteristics of selected group of clients.

Value Proposition: The collection of products and services a business offers to meet the needs of its customers.

Channels: A company can deliver its value proposition to its targeted customers through different channels. Effective channels will distribute a company's value proposition in ways that are fast, efficient and cost effective. An organization can reach its clients either through its own channels (store front), partner channels (major distributors), or a combination of both.

Customer Relationship: To ensure the survival and success of any businesses, companies must identify the type of relationship they want to create with their customer segments. Various forms of customer relationships include: personal assistance, dedicated personal assistance, self service, automated services, communities and co-creation.

Key Activities: The most important activities in executing a company's value proposition.

Key Resources: The resources that are necessary to create value for the customer. They are considered an asset to a company, which are needed in order to sustain and support the business. These resources could be human, financial, physical and intellectual.

Key partners: In order to optimize operations and reduce risks of a business model, organization usually cultivate buyer-supplier relationships so they can focus on their core activity. Complementary business alliances also can be considered through joint ventures, strategic alliances between competitors or non-competitors.

Cost Structure: This describes the most important monetary consequences while operating under different business models.

Revenue Streams: The way a company makes income from each customer segment.

Besides the approach of business model canvas, the SWOT analysis will be made in this report. SWOT analysis is a structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. The strength means that characteristics of the business or project that give it an advantage over others. Weakness stands for the characteristics that place the team at a disadvantage relative to others. Opportunities are those elements the project could exploit to its advantage. And threats should be the elements in the environment that could cause trouble

for the business or project. Identification of SWOTs is important because they can inform later steps in planning to achieve the objective.

3. Research Problem and Methodology

3.1 Research problem

Hevner and Chatterjee (2010, p.23) define design science research (DSR) as a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artifacts, thereby contributing new knowledge to the body of scientific evidence. The principle of DSR method is to create an innovative way to solve the practical issues in people's daily life. For instance, the existing Chinese elderly-care business model may not completely solve the basic problematic issues in urban home living Chinese elderly group, therefore the current elderly-care model in China is needed to involve with some new ideas and involve with more elements for better meets the needs of the urban home living Chinese people. The author of this thesis aimed to propose a technical elderly-care platform into the current elderly-care ecosystem in China which was basis on the literature review and also involve with executable business model to support this whole elderly-care ecosystem. That is the reason DSR is the most appropriate method may be chosen for this thesis.[3]

There are many of excellent instructions for guiding the research process in design science, the Figure below is one of these instructions and it presents the general methodology of DSR. Vaishnavi and Kuechler (2004, p.18) propose the advantages and reasons to select Figure 3 as DSR process methodology due to it emphaseizes the knowledge generation inherent in the method and it originated in an analysis of the process inherent in any design effort.

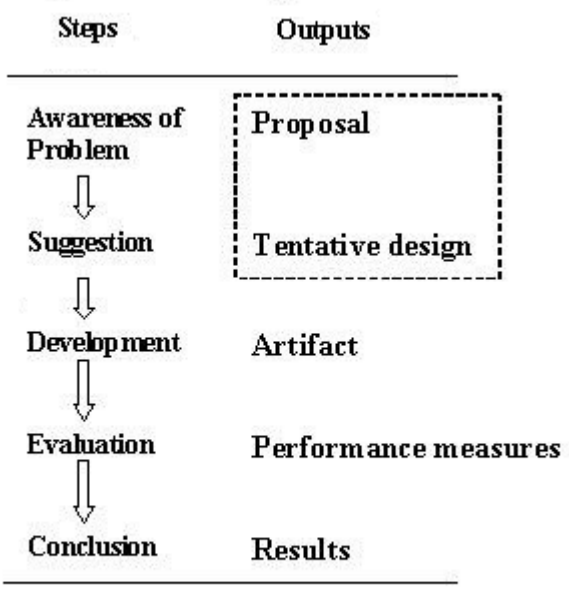

Figure 3. The general methodology of design research (Vaishnavi & Kuechler,2004).

The Figure 3 shows five basic process steps on design science research which include awareness of problem, suggestion, development, evaluation and conclusion.

The research problem of this thesis was the many of problematic issues related to current business model of China elderly-care service. With the large increased numbers of elderly population in China nowadays and the other reason such as inefficient bed supply and lack of elderly-care facilities, more and more urban Chinese elderly choose to live at their own home. The literature review part of this thesis promoted the main problematic issues in practical. After identifying ICT solutions in each issue, the author promoted a technical platform and related business model which is aim at solving all the issues. The objective of this thesis was to create an ICT enabled business model which can provide related solutions in every roles in the Chinese elderly-care ecosystem based on a literature review was proposed. The research question of this thesis was "To identify a business model supported by ICT solutions to establish a new elderly-care ecosystem aims to solve the essential problematic issues of elderly-care in China".

In present, Chinese major aging problem is locating at the home elderly-care mode as introduced in the literature review. So in this paper the business model to answer that home elderly-care mode will be the emphasis of discussion. According to the previous chapter description, the business model needs to satisfy the demands of safety and healthy

by customer and the interests of other stake holders in the system. Besides, a technical platform design with all reasonable ICT solutions to support that business model will be promoted properly.

3.2 Research methodology

3.2.1 Business model

The business model canvas is made up of nine building blocks: Customer segment, Value proposition, Customer relationship, Distribution, Key activities, Key resources, Key partnerships, Cost structure and Revenue streams. In the elderly-care business model, it is able to configure the nine building blocks by practical status.

Customer segment

Apparently the elderly is the direct user group in the customer segment. There are some common features for that group. Usually they are not able to have solid knowledge background in the modern technologies or concepts. For instance, how to setup an app in latest iphone. Moreover, a number of people in that group collect population averagely less incomes and even part of them are in the poor class. And in chinese culture, it is a tradition for the younger generation to support or maintain their parents or even grand parents in the family. The younger generation in the family naturally considers such elderly-care activities being their responsibilities. But due to the practical work or living problems, it is almost impossible for take that responsibilities in real time. So such kind of ICT enabled elderly-care solution could be one option for that group to satisfy their demand. while identifying the customer segment, it is necessary to classify the users and buyers into different roles. The direct users are the elderly, but the buyers of services could be elderly themselves or their children or family relatives. And even in practical piloting cases, the younger generation group will be indirect users in the model. Information management is a key service in the elderly-care platform, much of the information services needs to be reacted at the first minute. For cost wise reason, the younger generation is one of the receiver groups and they intend to have the real time information. As value of the elderly-care service platform, the customer group will not need to realize the other roles in the map. All their requests will be processed on the

platform automatically, which could make it easier to use the platform and involve as many customers as possible into the business model.

In the other dimension, the service provider is another customer in the platform. Usually the service providers will provide daily supports to the above customer groups. But in this business model, the platform will bring much more online to offline business opportunities to the service providers, which is also beneficial to provider group. The elderly and service provider groups could have positive cross-side effects on each other in the model. The more users registered in the platform, more service providers will be attracted to join the service resources team. Then more service categories with better quality provided into platform, as a result more users will be attracted to join the platform. The business platform is like the Alibaba, which has grown to the largest e-commerce platform globally, but focusing on the elderly-care local service.

In this business model, the elderly, elderly's family and the service providers make up the customer segment and in positive mode they should react supportively and productively to each other.

Value proposition

The key value proposition could be classified by different customer segment. For the elderly, it solves their key demands in safety and healthy areas. In most home living scenario, how to recognize and response the safety and healthy incidents of the elderly without highly maintenance costs would be an most concerned topic. Most of home living elderly are taking risks on safety and healthy, the ICT enabled solution could partly guarantee their security and more importantly deliver a kind of safe feeling to their mind, which improve their living quality physically and mentally. Meanwhile, it should satisfy the requirements by younger generations as well. In present China, it is common for young generation to work in wealthy cities which might be far away from their home. For a traditional reason, it will be considered totally immoral to leave parents living alone when they are old. It is impossible for the children to provide personally accompany and care to their parents, but such kind of ICT enabled elderly-care service could be customer's assistant to manage key information with a productive real time method, which solves the younger generation's problem with reasonable costs. Besides the direct customers, the service providers could have more business opportunities. And under the cross effects, more customers will be involved and better quality of service will be driven

based on the complete marketing competition. The roof of value proposition could even grow accompanied with the development of business model. Despite commercial layer, the public sectors will benefit from the business model as well. Mass of practical information about elderly aging will be easily accessed and managed by the central government, and it is valuable for the centric integrated type of social management to maintain the stability of society. And in the other hand, the corresponding policies which are synchronizing to real time aging problem will be beneficial to most the elderly. The elderly-care business model is able to solve the social aging problem effectively.

In a word, the value of such model should enable the direct elderly users to enjoy higher living quality at home, meanwhile satisfying the requirements of family younger generation. Besides, creating more commercial opportunities for business operators. Moreover, beneficial for both public sectors and aging population to establish a better world for the elderly.

Distribution channels

The distribution channel in this business model would be the elderly-care information management platform. All of the above value propositions could be only delivered via the platform by information management flow. Such distribution channel is cost wise, reliable and easy to maintenance and update. As the growth of elderly-care service in the business model, the platform working as channel will become a unique resources for the general operator in such model and remain the leading position of operator in elderly-care industry.

Customer relationship

In the business model, all users will need a membership in the system. Furthermore, users' information will be collected and managed in the information platform by different classifications. Theoretically, as the service accumulated by time, the service platform will learn individual living behaviors. More and more true information will be stored in the platform which will definitely strengthen the customer's loyalty.

Besides, another productive approach to maintain customer's loyalty is to introduce the complete marketing competition, which will naturally involve the customer to react with other roles and improve the quality of services. As a result closer customer relationship will be made.

Key activities

The key activities would be promotion of the business model to the other players in the ecosystem like customers and partners. In China, the elderly-care service project is common to have governmental department leading the initial activities. First of all, for such kind of public well-being project, it is governmental responsibility to invest and manage for a good result to the society. In the practical experience, it is an available approach to present the project plan to government office for initial financial and resources supports. The supporting strength depends on the wealthy level in that area, but it is usually about 2-4 million RMB. More importantly, such financial support usually aims at demo result, for instance a piloting project. It is a neutral beneficial activity. The commercial operator could earn valuable initial resources and piloting opportunity that even being stood by governmental representative, which will make the business easier acceptable by customers. In the other hand, the government office could create impact to the public that it is a responsible service force for the citizens, which could increase the recognition and support from the public. Such piloting opportunity supported by government will be one of most important activities in China elderly-care industry. Besides, it will be also important to maintain the reliability of the operation of elderly-care service. Any unexpected technical problems will destroy the loyalty of customers by long time.

Key Resources

The key resources in the business model would be the stability of technical platform, reliability of user-end devices, quality of elderly-care services, intelligence of the solution and qualified supporting resources. All of those would be the key to success of the business model.

Key partnerships

The business model is based on a technical information service platform. Partnership with public sectors and network operators would be important to guarantee the key activities and resources. Commercially, the mobile operator and network operator would work as media to support the distribution of value proposition to customers in the platform. Their huge distribution network and amount of users could help the platform to access

consumers market with less cost. Then by the project moving forward, a group of verified technology providers and qualified service resources providers would closely work with the platform.

Cost structure

In the business model, the value proposition is based on the information management platform and a personnel gateway that is presented as a wearable hardware like elderly-care smart watch. The R&D work of above hardware and platform will consume an amount of resources and there is risks on delay or even failures on the final deliverables. After the R&D phase, it needs to reserve more resources to maintain the platform and hardware for the sustainable requirements. Besides the technical related costs, the promotion of business model and selection of service providers will consume the R&D equally costs.

Revenue stream

User device sales could be the most direct revenue stream in the beginning phase of the business model. Such sales may not create high profits for the business in short term, but instead the cheaper price of device will be easier to attract more customers at the beginning and accumulate a considerable number of users in a period, which will be an important factor to convince the venture capital to invest more resources on the business model to take bigger market share. Such investment could be considered as kind of financial support to the business model while the raising period of market. By the growth of the amount of users, the elderly-care platform will have better visibility to the public and better economic impacts on the advertising activities, which could be a sustainable increasing revenue stream in a long period. Besides, thousands of service activities are occurring on the elderly-care platform every day when the number of users has been raised. As the platform service provider, broker fees by little percentage for those commercial service activities will sum up an considerable amount which could be seen as an important revenue stream for this business model.

3.2.2 Elderly-care platform

To enable the elderly-care business model to be an available solution in practical use, the information management platform is an important approach to be implemented in the

piloting project for the proof of concept. The conceptual design of platform by the view of service is demonstrated as below.

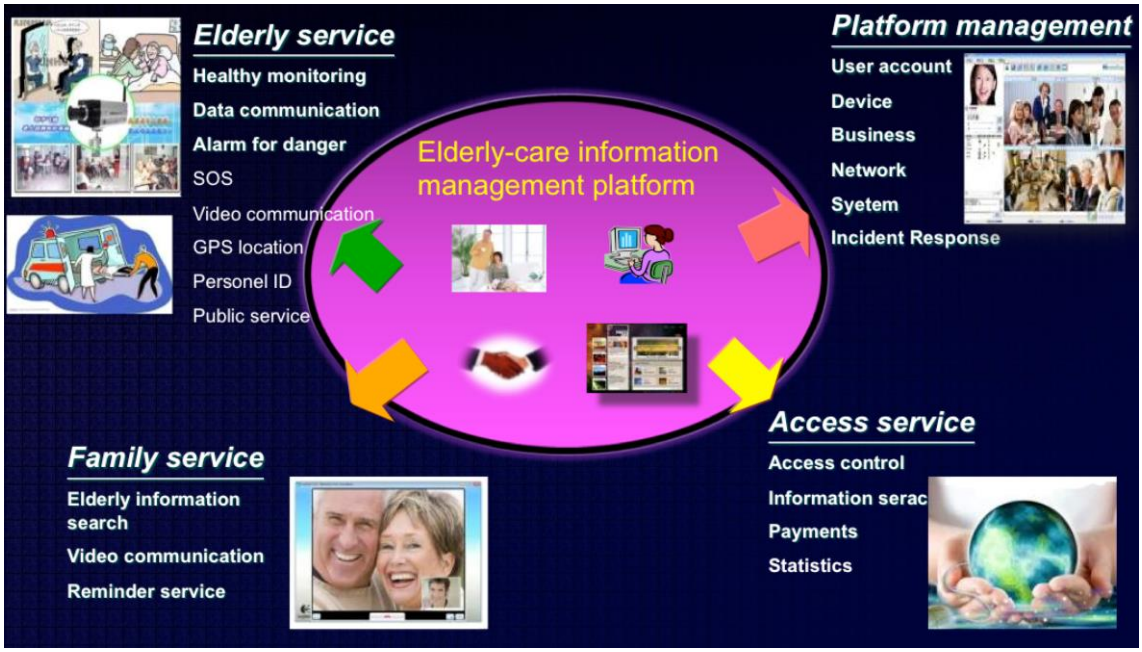

Figure 3 Service conceptual design

As the service conceptual design stated, the platform will collect the elderly healthy data via personnel terminal such as wearable devices and make responses to corresponding activities of the users for example falling or SOS call. Then such service information could be synchronized to the family and service providers who have strong intention to be involved. Besides, the platform could record the basic information of elderly users when registration was made. So while service were being requested, users' information could be transferred to service providers beforehand. Furthermore, the location information could be collected in real-time so to guarantee the reach of such services. Accompanied with the services, accounts of users and service providers will be managed on the platform. All services and payments will be processed on the platform as well.

To realize the above concepts, the architecture of platform was designed as the figure below.

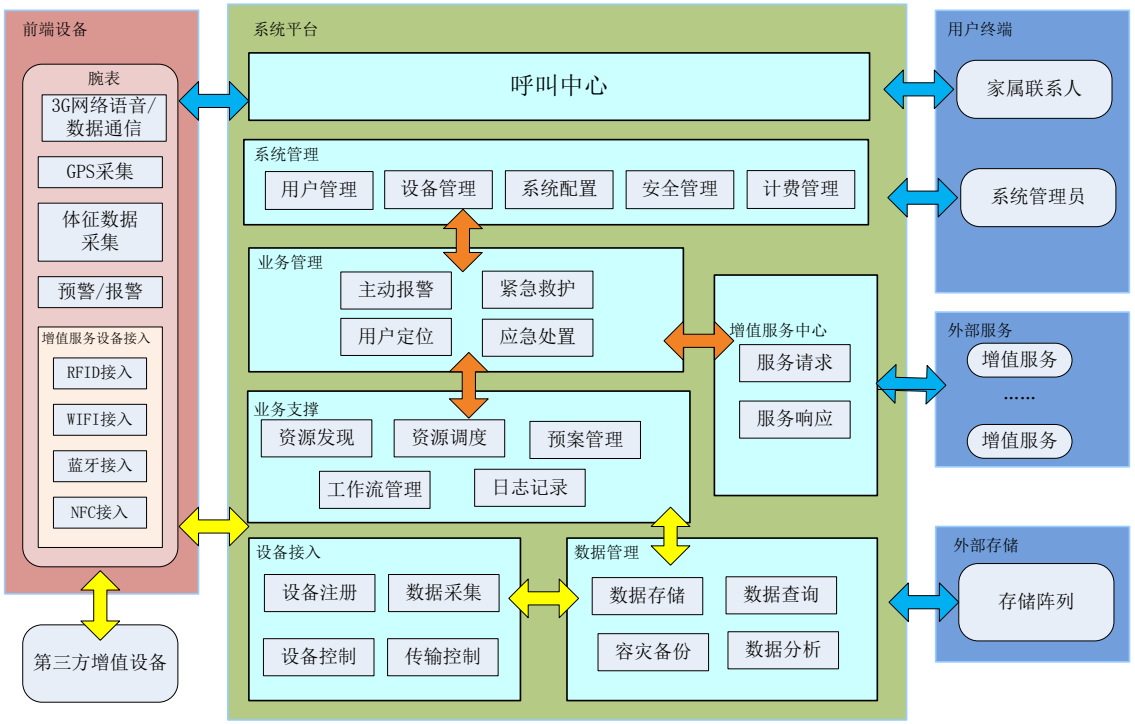

Figure 4. Architecture of elderly-care information management platform

There are 5 major building blocks to make up the entire architecture: information management system, user-end devices, service interfaces, external 3rd party service management and external data storage.

Information management system

The information management system is the key hub in the entire design and it is made up of 7 different sub-systems: calling center, system management, business management, supportive center, value-added service center, registration control and data management.

a) Calling Center

The calling center is a direct response service interface for elderly users. As learned by chinese market status, the elderly are the most conservative group of consumers who have less motivations and competences to learn modern IT service that driven by complicated operations. So it is important to design elderly-care service by the most simply traditional approach such as calling service but easily accepted by elderly-care users. In the design, each user will have his/her own wearable device which could support communication to calling center. In practice, while the users having a service request, a traditional call could be made between the calling center and the user that may take least operation challenge

for the elderly, which could motivate the users' maximal applications. The calling center's duty is as the assistant of elderly users. It will collect users' service requests and forward them to corresponding service providers on the information platform.

b) System management

The system management component is charge of user accounts, device registration, system configuration, security management and payment management. The status updates will be relative to business management component.

c) Business management

Business management will monitor the information of users. If any requests were triggered by elderly user, it will conduct such information to other components of system management, supportive center and value-added service center.

d) Supportive center

The supportive center is the major Once the service requests were conducted from business management component to supportive center, the corresponding resources will be distributed to response such requests. The work flow and work logs will be recorded in real time for further analysis and services.

e) Value-added service center

The value-added service center is responsible for feedbacks to requirements from business management. If the users are asking services despite of basic emergency ones, the requests could be classified into value-added category. For example house keeping service or food delivery service, the value-added service center could deploy those services requests to external service providers.

f) Data management

All data of the service related operations will be stored and back-up. Meanwhile the data will be mined and analysed to sort out the consumer's behaviors for further services and promotion work.

g) Registration control

The personnel devices by users will be registered after activating, the status of all devices will be monitored and managed by the registration control component. If any failures of devices happened, the response would be acted by registration control component. Besides, the data collection and transitions on the device could be managed by the registration component in real time, which could enable or disable functions on the devices and adjust the frequency of data transition.

User-end devices

The user-end device which is a personnel elderly-care watch will support the functions of healthy monitoring, GPS location and data communication. Typically the elderly's personnel physical data such as heart rate could be watched by the device and updated to the platform via the communication component such as GSM module in real time. Any abnormal status could trigger a call from the platform to the device, which could help the care support clarify the situation of elderly users. Meanwhile, the GPS position will be activated and synchronized to platform for service people. So in emergency situation, the user's security could be guaranteed by user-end devices. Besides, the user-end device could work as a gateway to communicate data between other 3rd party devices and the platform. All the significant data collected by the other devices need to be uploaded to the platform via the user-end device, which means that the user-end device will be the unique interface of data access in the platform.

In daily life, the user could intentionally activate a service request via the communication between user-end device and calling center. The requests would be transferred to platform and conducted into the services management process.

Service interfaces

The service interfaces is web based or even mobile app based. The elderly family, service providers and service management entities will register themselves and access their information by such interface. For example, if a falling accident of an elderly user has been detected, the platform will verify the situation by its calling center firstly. If the situation is a true case, an alarm and the basic information of corresponding user will be sent to the hospital emergency service and the family members via the service interface. In the other time, the family and service providers could search for user's profile and check the updates by the same interface.

External 3rd party service management

The platform is designed to be an eco-system which could involve any 3rd party services that is able to be compatible to the gateway and protocol of the platform. For example, if the user would like to measure blood pressure and upload the information to the platform so the user's health profile could be continuously updated with real-time data. Driven by the demands of customers, the blood pressure manufacturer would adapt its product to the platform interfaces. On the platform, there is a system to manage accesses of the external 3rd party services. If any service fails to the qualifications by platform, it could be requested to improve or banned so on the user end it will be a service quality oriented business model.

External data storage

For the platform service, the most valuable asset is the data of users. A lot of further value-added service and revenue stream could be developed based on the real-time data of users. So the external back-up data storage will be extremely important for the platform owner. There should be a mechanism to automatically back up the database of platform to an external data storage in a certain period. The technology to guarantee the security of such external data storage should be similar to common cloud service.

4. Discussion

4.1 Case study

4.1.1 Platform in general

The ICT enabled business model for elderly-care is a completely theoretical design based on the current situation of Chinese society. A Chinese company called Wuxin was initialled to implement the technical platform and pilot the business model in two different Chinese cities in 2013-2015 to verify the feasibility of such model in practical.

In the cases, Wuxin plays the owner and operator of business model. It built up the information management platform according to the theoretical design and organized the private users, public sectors and 3rd party service providers into the piloting project to verify the business model and improve it to commercial applications. There are different roles in the piloting project as figure5 below.

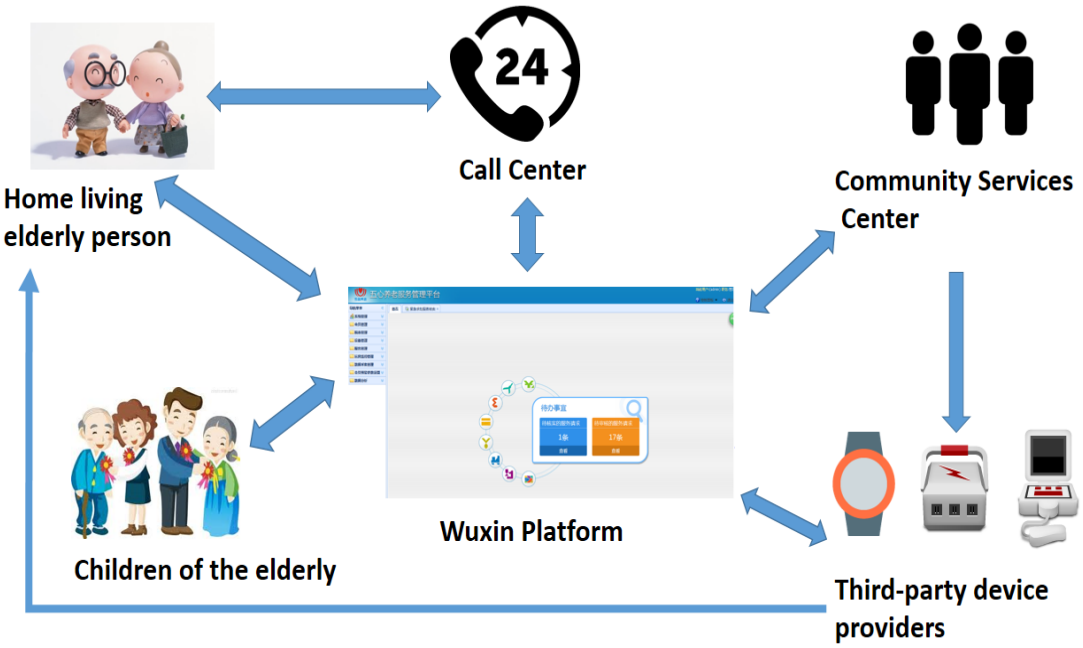

Figure 5. Technical platform design

The user's profiles were registered into the information management platform while introducing phase of the elderly-care services to the home living elderly. And each elderly user could be identified with an individual Wuxin smart watch. The watch would

automatically monitor the daily status of users and enable the elderly users to contact the calling center when any service request was triggered. Furthermore, the platform will study the continuous data from the users and map the most appropriate service resources with the right customers. For example, the platform could study the taste of the users and dispatch the meal orders to the corresponding restaurants once the service requests were confirmed.

The other roles in the figure will keep connection with the platform and react accompanying with the status change of others. The services on the platform will include the emergency response, medical supports, daily assistant, shopping supply and mental entertainment etc, All of them could be delivered to the calling center and the staffs in calling center will be assign the services requests to the third-party device providers.

After the services, the elderly person would be asked to feedback to the experiences. The quality control of services could be taken by the administrator of the platform. There are rules being clarified to the service providers and the qualification system could guarantee the most competitive service providers will be sustainably working in the supply chain.

Besides, a pre-paid system would be applied as the payment approach in the platform, which could allow the flexibility of financial issues for the operator of business model.

4.1.2 Interfaces in the platform

Structure of the platform

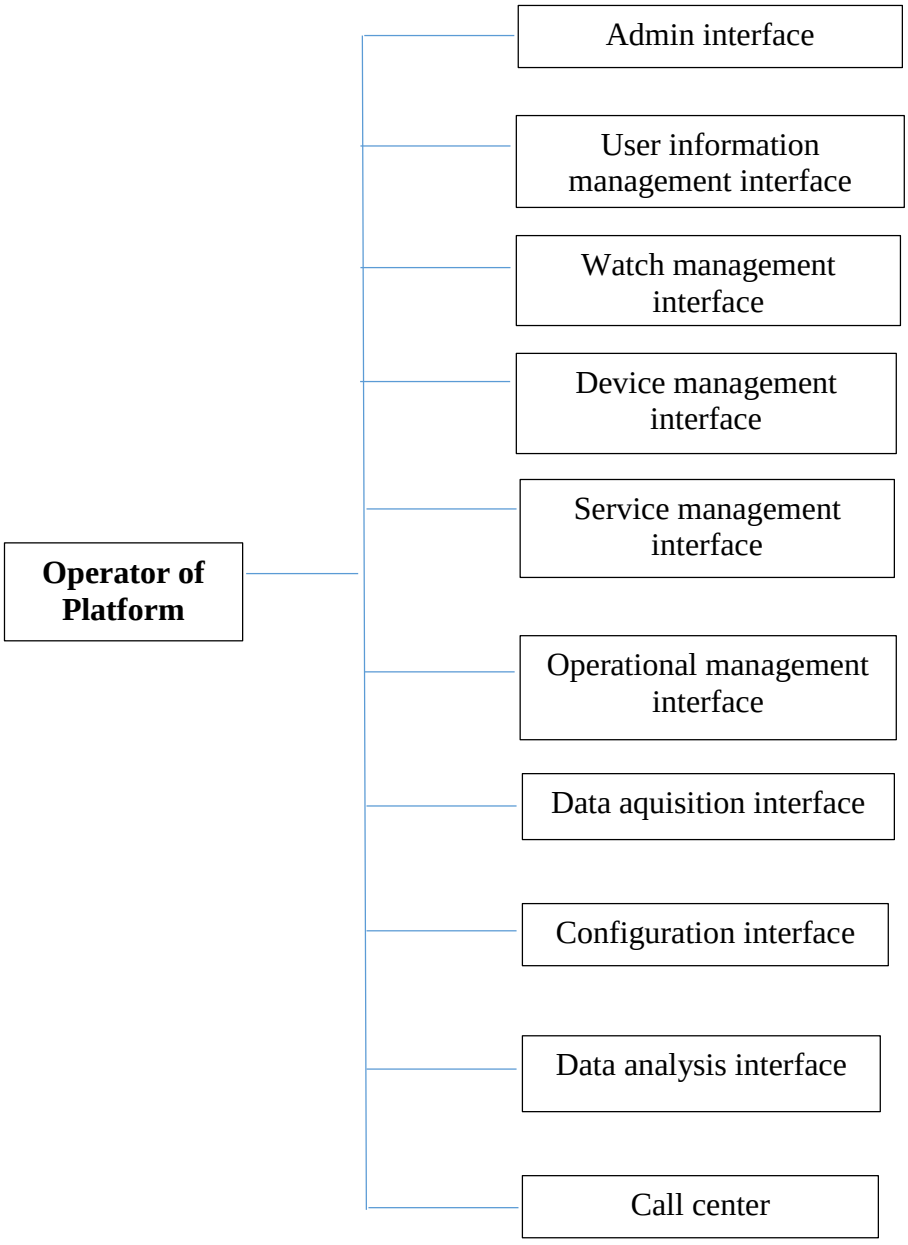

Figure 6. Structure of platform interfaces

The operator of elderly-care platform is able to access the service via 10 different interfaces. The functions of the interfaces will be introduced in following.

Admin Interface

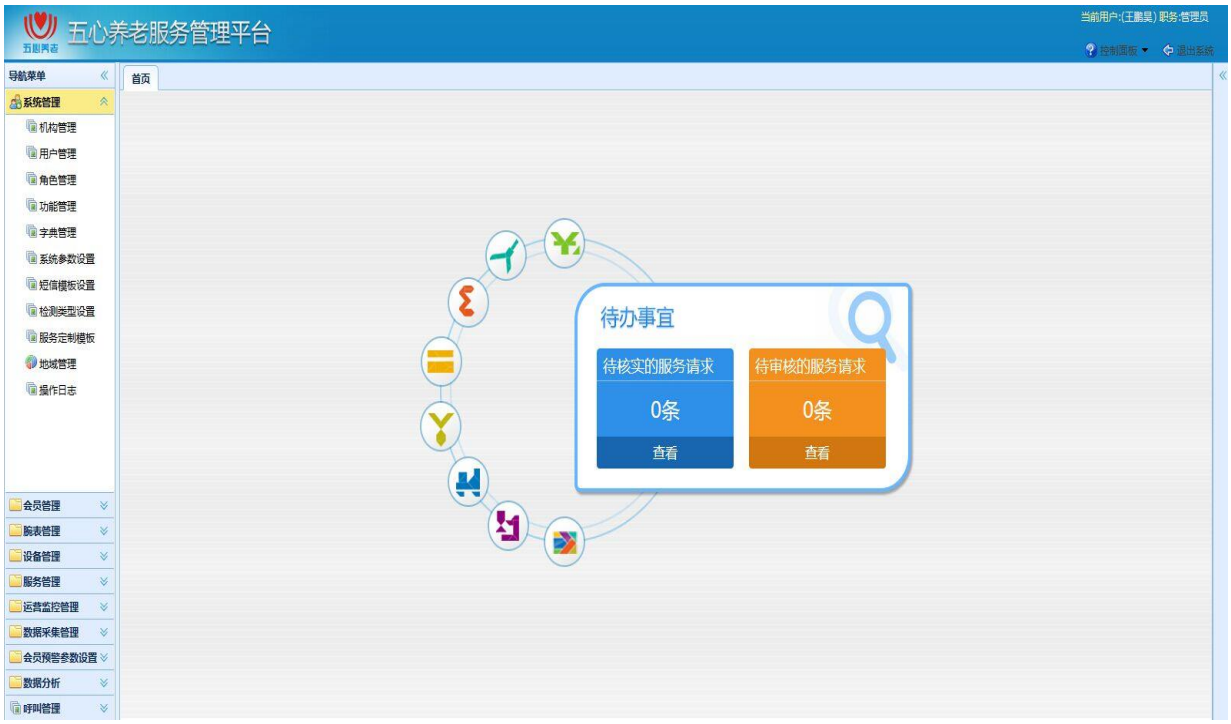

Figure 7. Admin interface in Wuxin platform

The admin interface in Wuxin platform was demonstrated as above, the administrator could manage the different roles, users, service providers, functions, locational information of users in the interface.

User information management interface

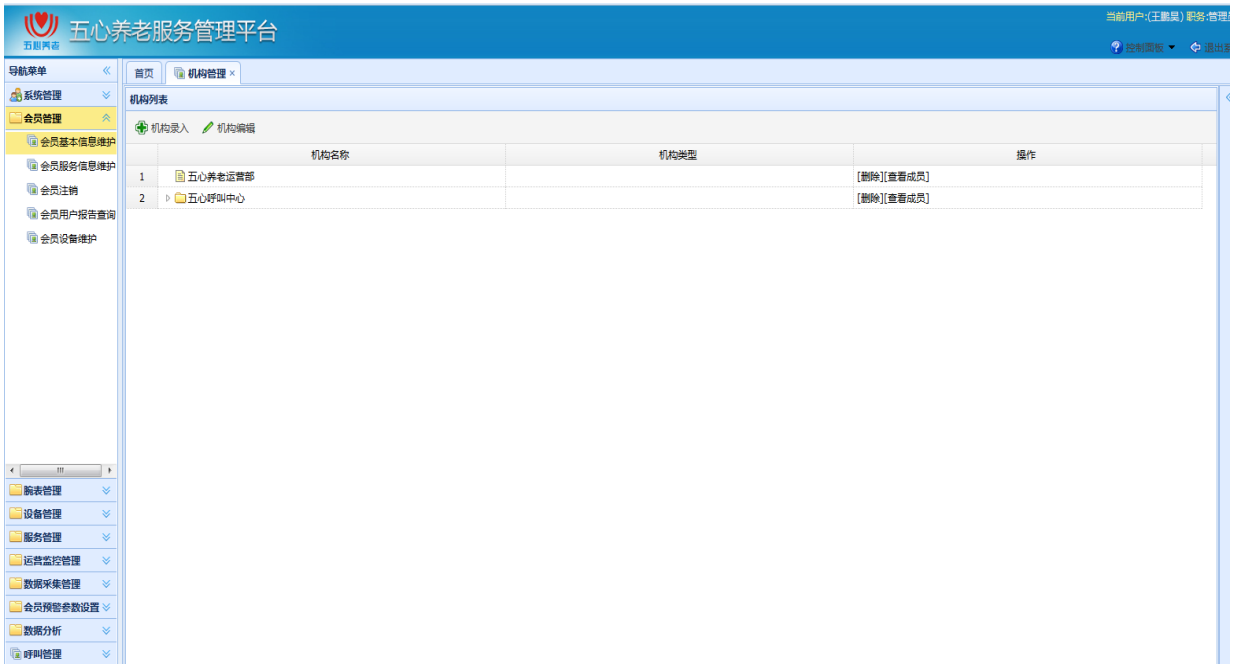

Figure 8. User information management in Wuxin platform

In the user information management, the administrator could manage and modify the basic information of users, register the validation or invalidation of users, maintain the customized services and 3rd party devices to the customers.

Watch management interface

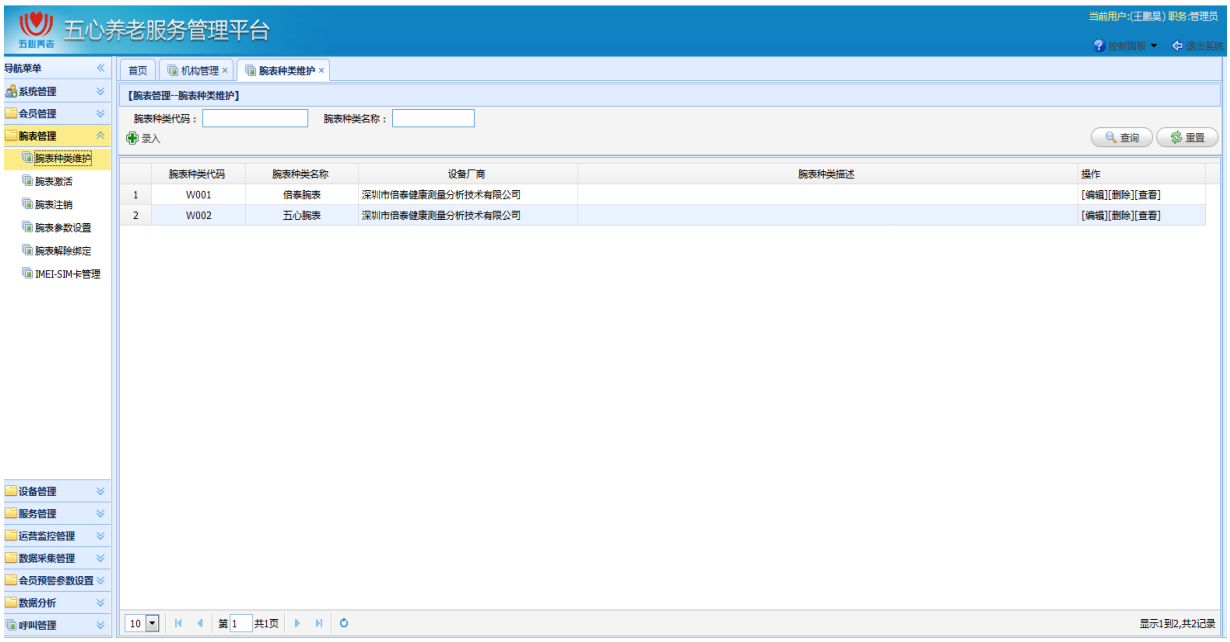

Figure 9. Smart watch management interface

The elderly smart watch is the unique individual device to connect the elderly users and Wuxin platform. The figure above shows the smart watch management interface, which supports the functions of watches validation, cancellation and configuration, IMEI- SIM codes management.

Devices management interface

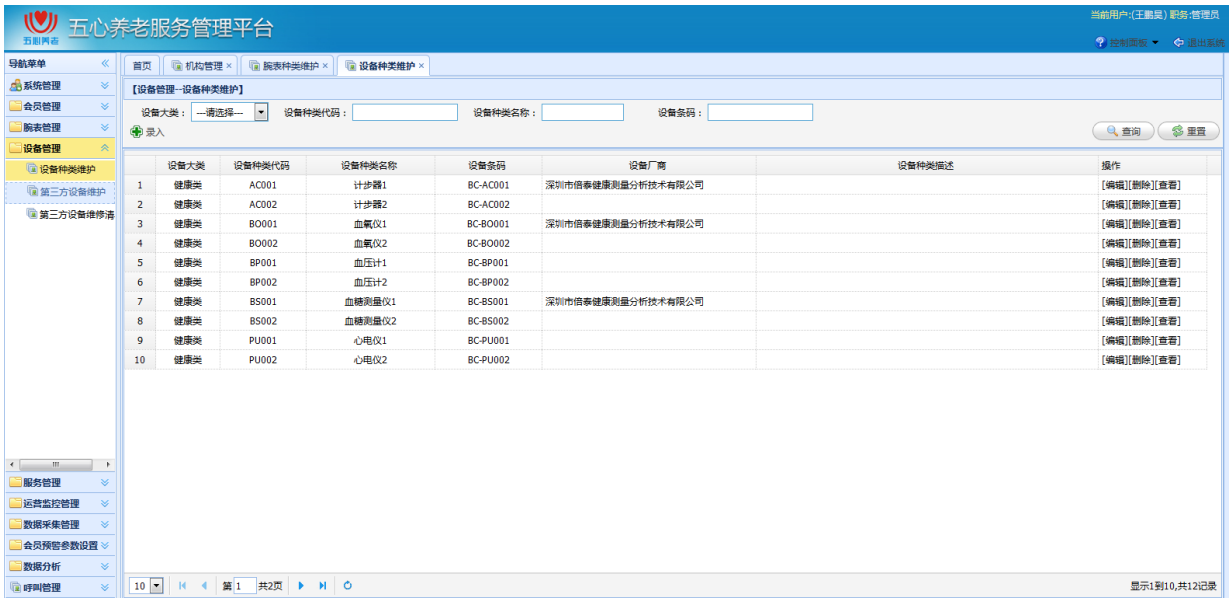

Figure 10. Devices management interface in Wuxin platform

Device management interface is for managing all types of devices provided by the 3rd party vendors, such as blood pressure meter, oximeter, glucose meter, temperature gauge and so on. The Wuxin platform can support functions of edition, modification, access, cancelation of all 3rd party devices and its information.

Service management interface

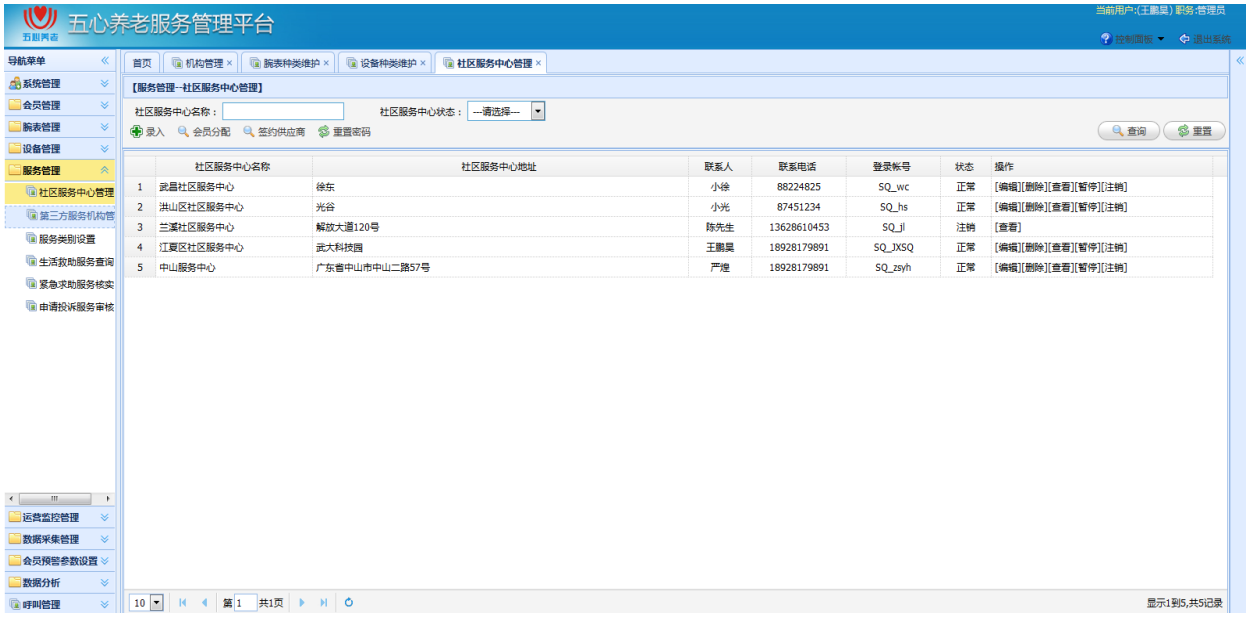

Figure 11. Service management interface in Wuxin platform

The service management interface includes the functions of community service center management, third party management services, service classfication management, daily assistance management, emergency services and service feedback management. This interface is the core part in Wuxin platform and responsible for providing the highly qualified service to the customers.

Operational management interface

Figure 12. Operational monitoring interface in Wuxin platform

The operational monitoring interface provides a more intuitive approach to management for staffs in Wuxin platform. The operators could be more intuitive to observe all members of the state, service status, and status of the device and the state of emergency warning status by displaying charts, graphs and figures. Therefore, it could enable the operators to identify problems and solve them in the real time.

Data acquisition interface

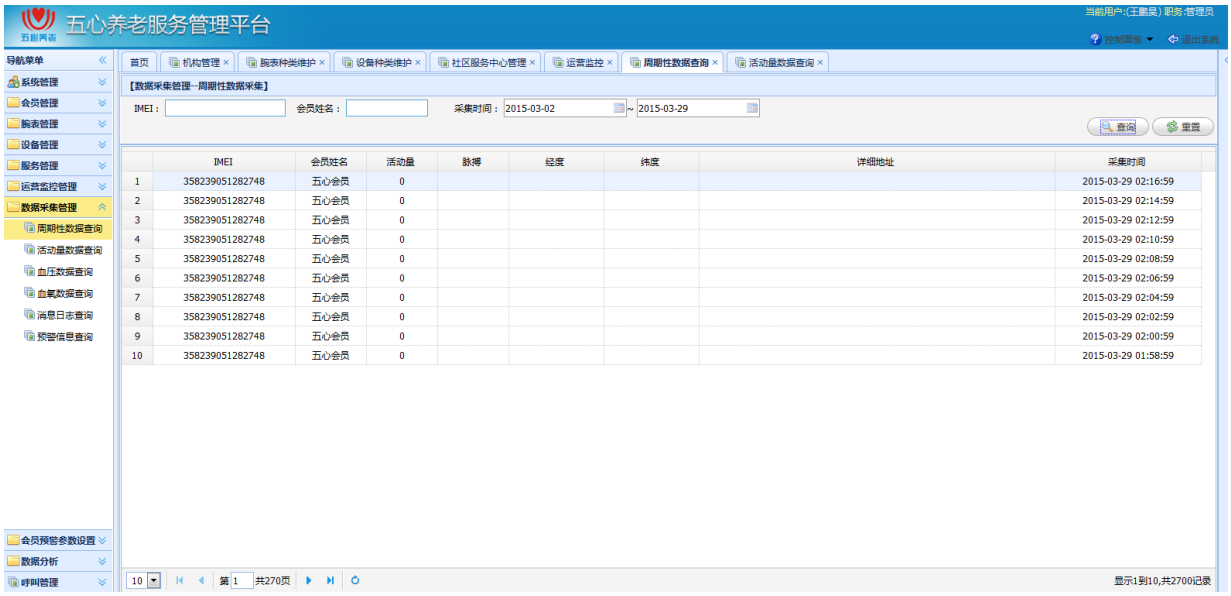

Figure 13. Data acquisition interface in Wuxin platform

The data acquisition interface is mainly used to display the periodic data collection, daily activity, blood pressure, oxygen, warning data of elderly people.

Configuration interface

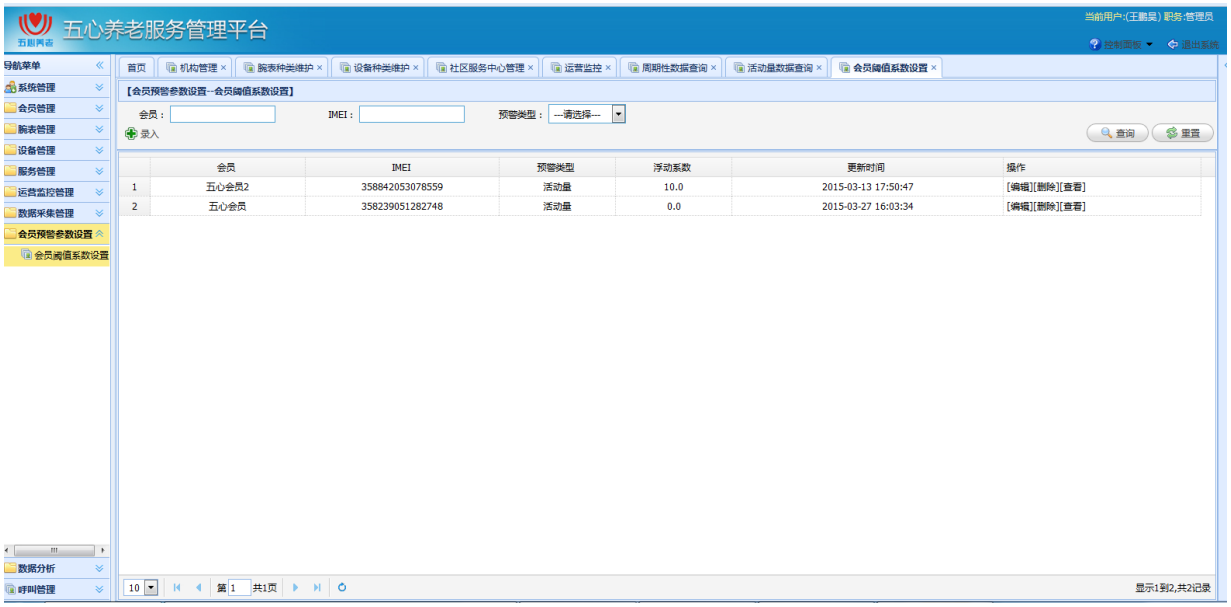

Figure 14. User parameter configuration interface in Wuxin platform

The user's parameter to trigger alert could be customized set on the configuration interface, which could help users edit and modify the smart watch warning type, floating coefficient with more flexibility to meet different user's individual requirements.

Data analysis interface

Figure 15. Data analysis interface in Wuxin platform

The data analysis interface through the histogram clearly shows the user various types of information such as the geographical distribution, the distribution of time watch, watch frequency of useage at different times of circumstances. This could allow a continuous study and research on users' behavior and help the platform become more intelligent and automatically be mining the user's information, so that the Wuxin platform provides services more accurately.

Call centre

Figure 16. Call center interface in Wuxin platform

The call center is the unique interface between Wuxin platform and elderly users. It will process all the requests of services by the elderly users. The elderly can trigger a connection via the smart watch to the Wuxin platform. Meanwhile, the coming call message will also be displayed on the interface of Wuxin platform which is shown on above figure and waiting for processing.

Elderly TV interface

Figure 17. The elderly people interface on TV port

The Wuxin platform specifically designed an interface for the elderly person use in television. The elderly person turn on the smart TV and land this Wuxin interface to check their own information and physiological data. It is easy for elderly to press 1,2,3,4 button

on the remote control and check the different information they ask for, such as personal information, physical health data, user reports and customized services.

Figure 18. The elderly people profile query on TV port

The figure 17 shows the basic information of elderly person after the elderly person press button 1 on the remote control, the basic information include name, gender, age, phone number and current living address.

Figure 19. The elderly subscription service queries on TV port

The figure 18 presents the daily health data of elderly person after the elderly person press button 2 on the remote control, the daily health data shows the elderly person whether his body condition stays in a health range.

Figure 20. The elderly information report presenting on TV port

The figure 19 shows the user report of elderly person after the elderly person press button 3 on the remote control.

Figure 21. Customized services for elderly people in Wuxin technical platform on TV port use

The figure above presents the customized service the elderly person ask for after they press button 4 on the remote control, the daily health data shows the elderly person whether his body condition stays in a health range. The elderly people can be freely defined service type, service content, hours of service they need through this module.

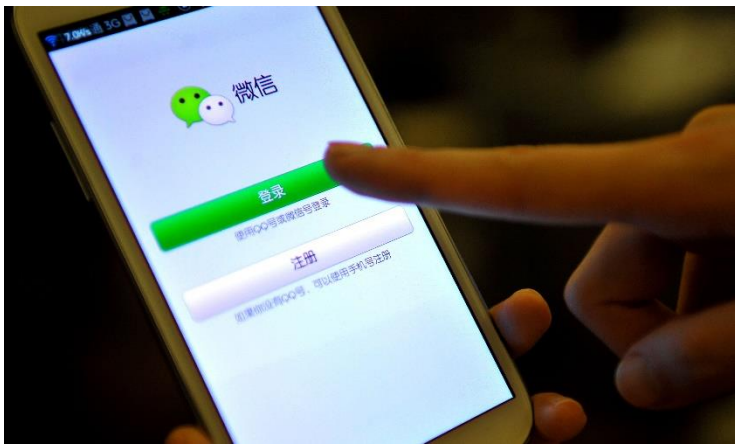

Figure 22. Wechat app in mobile phone

Until January 2013, the total number of wechat users breakthrough 400 million daily and its active users over 100 million, there are 70 million overseas users. That's more than 400 million users, 74% of 20-30 year olds. Therefore, in order to be in line with the user' habits, wechat is more convenient for the elderly people's children who can check their parents information remotely.

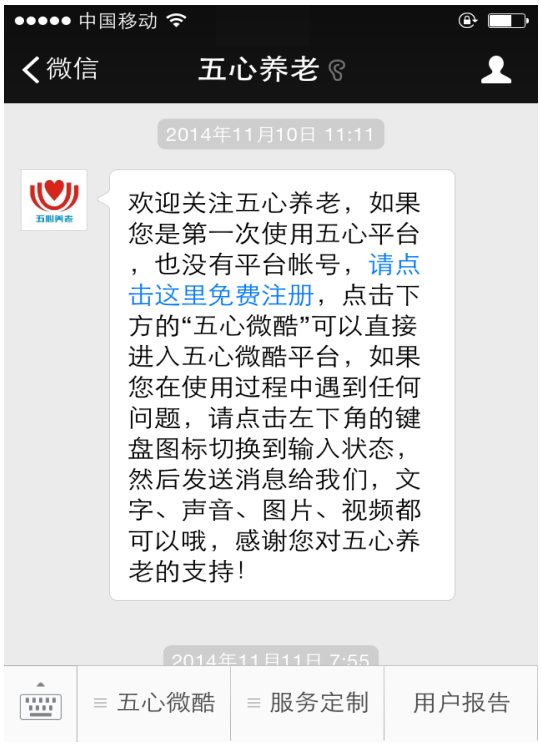

Figure 23. Wuxin public port in Wechat

The piloting project is specialized on wechat public ports to facilitate the elderly's family to check the user's health information, customized services, personal data and daily physiological data as the figure 22 shows above.

Community service centre

Figure 24. The community staff to process the requests of the elderly people

As seen by the figure above, the community service center takes responsibilities for the elderly call requests and assigned to a 3rd party service providers, it can be seen on the figure above, the community service center can easily figure out that the number of service requests pending and number of service requests processed in the interface of their own. Any request for community service center are recorded in Wuxin platform database.

User profile interface

Figure 25. The community staff check the requests history from the elderly people

The community service center also have access right to review the basic information of elderly people such as name, gender, age, phone number, a number amount of requests,

amount of complain and service customization statues. Meanwhile, the staff in the community service center also have right to view the customized services the elderly people are using currently.

Figure 26. The community staff check the 3rd party service providers' information

The staff in community service center will assign the service requests to a selective 3rd party service providers to response to the user's request. On the other hand, the community service center is also responsible for auditing to 3rd party services providers. For the unqualified 3rd party services provider , the community service center can also send a complaint to the Wuxin platform.

3rd party device provider

Figure 27. The 3rd party vendors interface

The 3rd party device providers can login the Wuxin platform and read the interface shown in above figure. The 3rd party vendors could view the subscription information, scale of services, and feedback by the customers. The purpose of that interface is to enable 3rd party devices providers to have a comprehensive understanding of their own services and provide qualified products and services to the customers.

4.2 Discussions on results of piloting project

The piloting project was initialled since 2012 in two Chinese cities of Wuhan and Zhongshan. Wuhan is the capital city of Hubei province where is the Chinese average wealth area. And Zhongshan is one of the richest cities in China. The results of piloting projects in both cities would present the most probably optimistic outcomes while application in broad areas in China.

4.2.1 Success of the piloting

The most important success or positive impacts by the piloting project is to introduce an elderly-care concept which is supported by a modern information management platform to the customers who own less knowledge on information technology and governmental sectors who are able to assign public resources to serve elderly-care industry. Furthermore, in both piloting sites the customers are holding an open and welcome attitudes to be involved into the program and the governmental sectors showed heavy interests in the revolutionary business model and technical approaches to solve the aging population problems. As a part of governmental responsibilities, they could not avoid the aging problems and would like to explore some new approaches to resolve the aging challenges. In both piloting sites, the governmental sectors invested 2 million RMB to support the commercialization of such concept to practical application. Apparently, the public sector would like to help the development of elderly-care industry and expect to generate an innovative solution to cover most of current problems. The smart elderly-care concept and solution has been realized and identified by the government as one option in near future though it is not mature enough yet.

4.2.2 Challenges in commercial application

The business model was designed to satisfy requirements of different roles in the elderly-care platform, but in practical commercial applications there are challenges to overcome for improvements of current business model.

a) The users in the business model are the elderly and in design the model should support elderly daily life on the health and safety issues. But in practical, due to the limited background IT knowledge of most elderly users in China, the individual elderly-care smart watch is designed as a normal watch carrying a service button without any screen. Actually there is no much interactions between the users and devices unless service requests. Although most of user's activities and physical data have been recorded on the information management platform, less feedbacks according to the records will be made to the elderly users themselves rather than their family or service providers. In a longer period of piloting, part of users will reduce interests on the smart watch or even think it to be useless The elderly-care smart watch should be easy to interact and keep attractive to its users, which may be a major challenge in more broad application.

b) The elderly is the most conservative consumer group in China market, as a result the buyer in the business model was assigned to be their children who are young and the most wealth class in the society. And in Chinese traditional culture, one major responsibility of young generation is to support their parents' life in elderly age as return of parent's raise to their childhood. But in practice, a certain amount of elderly can not have supports from their children for a continuous period. In some cases, the children work and live far away from their parents, it is impossible to support their daily life even with modern technology support. In other cases, the parents have only one child in the family due to the Chinese population policy in past 30 years. When the parents become elder than 65 years, the child always had its own family and younger generation. To reduce the burden on the child's family, the elderly usually choose to self-support daily living. For the middle or high class of elderly, it will not lead to any problems. But to most elderly in poor class, it is difficult to overcome the challenge. If they want to enjoy a qualified living in elder age by support of modern technology, the service price which mostly afforded by the public sectors should be cost wisely.

c) Despite of the above customer relative challenges, marketing and distribution channel are another key topics to be studied. In the piloting project, the service and products were marketed site by site under the promotion of local governmental well-being office. It is resources consumed and less productive work. Especially in large scaling marketing phase, it is impossible to distribute services in such model.

In the business model design, telecom operators should be the most productive channels to distribute the services to customer segments. The TOP 3 telecom operators in China are state owned and to resolve the social aging problem will be relative to their political achievements as well. As learned from the piloting phase, the current business model of the China Mobile, China Unicom and China are very primitive, which is about call services and mobile networking services. All of those telecom operators are investing to develop new value-added ICT solutions for the consumer markets such as elderly-care and kid care. It will be interested to them if an innovative elderly-care ICT solution could be applied in their networks and there are strong motivations for them to drive the business forward.

In the practical context, the telecom operators are state owned and have its own branches in every Chinese provinces. In previous legislation, the individual branch has been authorized to decide what categories of devices would be sold with the subscription package services. For instance, the mobile phones always being sold accompanied with subscriptions and split the purchase expenses into a long period. The provincial branches could select their interested mobile brands to be partners and the final evaluation of their results is relevant to the number of SIM cards sold in each year. But since 2015, the headquarters of each telecom operators have taken back the rights to select mobile manufacturer partnerships from each provincial branch, so such kind of elderly-care smart watch which requires a new SIM card would be heavily interested to the telecom operators. And the cooperation with local branches on marketing and sales work would be cost effective to the ICT elderly-care operators.

4.2.3 Successful elderly-care service in China

Xiaoyu at home is a video and audio intelligent technology based elderly-care service aiming at the consumer market. The product is made up of a video computing device and a mobile application as figure 29 below.

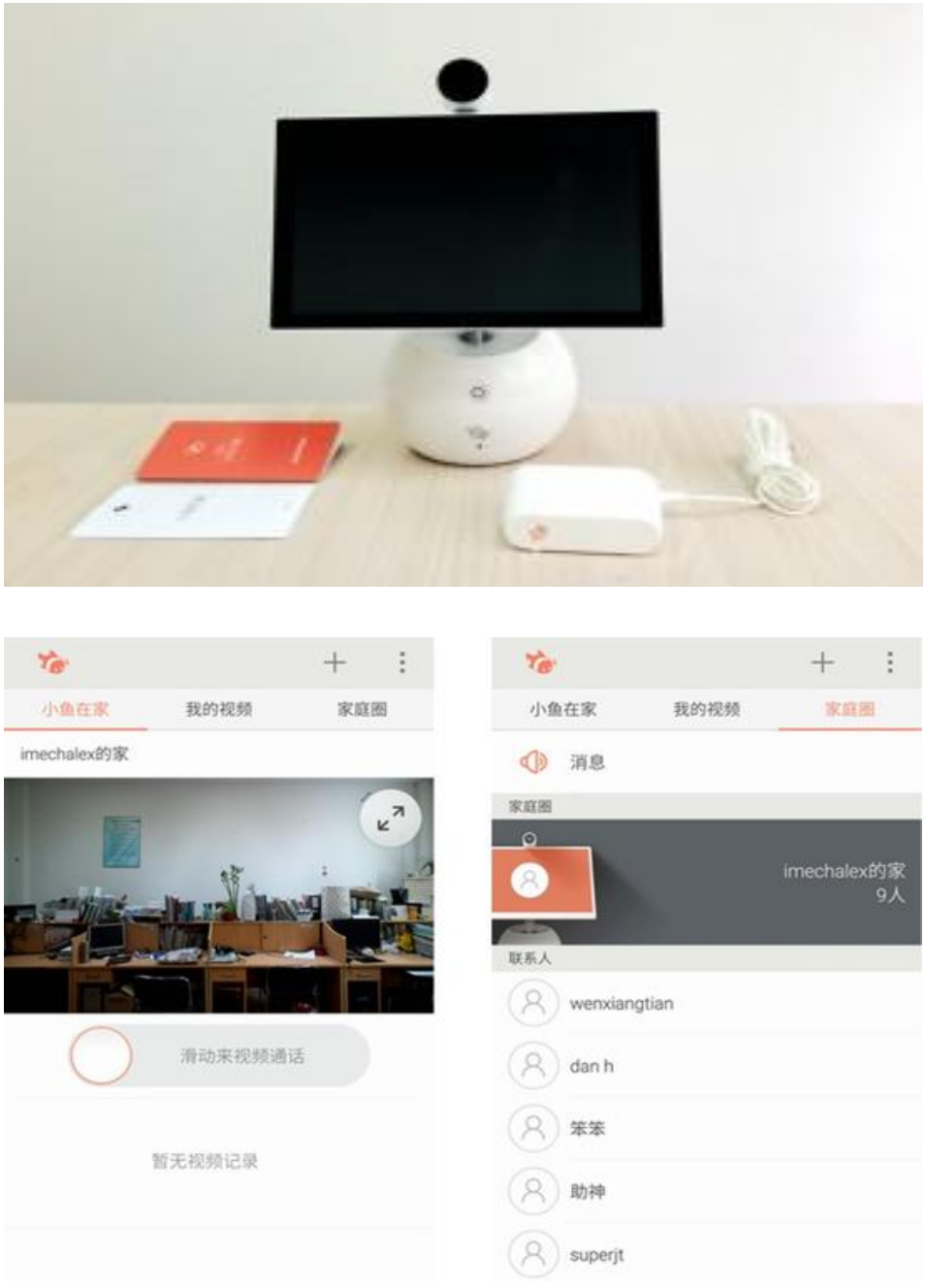

Figure 28. Xiaoyu at home product

The video computing device is installed at the elderly's home and the mobile application usually is carried by the family members. The video device is on standby mode in common, once the living activities of elderly at home were detected by its audio

intellectual technology, the device will be activated to monitor the activities of the elderly. If any abnormal situation occurs, the device could start to record the audio and video information at home. Besides, a notification will be sent to the family members on the app end to remind them a suspicious status occurred.

The user interface of video computing device is shown as figure 30. There are no complicated functions but the video communication. The interface is graphically designed for the elderly with poor eyes and less computer skills. It should work as easy as television to the elderly users.

Figure 29. User interface of video computing device

The objective of services are to simplify the video communication between the elderly and the younger family members, which could encourage more family communications between young and old generations and improve the quality of mental life for those elderly people living along at home. Meanwhile, it works as an intelligent assistant to monitor the daily activities of the elderly to guarantee their safety and timely response to emergency situation.

In 2014 the service was introduced to market and by the beginning of 2015 it has made sales of 5 million RMB by unit price 2699 RMB/user. The service vendor identified the demands of elderly at home accurately and create a new connection between the elderly and the family members by video approach to improve their mental life and daily security, which also lead a successful specific business model on elderly-care in China.[3]

5. Conclusion and Future Work

In the paper the study was set out to explore the ICT enabled business model for modern elderly-care service and has identified the nature and form of current business model for elderly-care service in China. An innovative piloting project on that subject and its impacts on the elderly-care industry even in the society were introduced and discussed. The study has also sought to clarify the context of elderly-care industry in China and different roles and their interests in that eco-system for further research on the feasibilities of the piloting elderly-care projects to sort out a theoretically successful business model for the elderly-care service. The general theoretical literature on this subject and specifically in the context of China elderly-care service is inconclusive on several vital questions within the identification of business model for elderly-care. The study sought to answer below questions:

1. What are the key issues for elderly-care users?

1. Is ICT method able to support modern elderly-care service?

2. How to identify a successful ICT enabled business model for China elderly-care industry?

The main empirical findings are in Research methodology and case study. This section will synthesize the empirical findings to answer the study's three research questions.

1. What are the key concerned issues for the elderly-care users?

To stay at home and enjoy a safely qualified life without sacrifice of privacy invasion meanwhile costing reasonable living and care expenses are the key concerns for elderly-care users.

2. Does ICT method benefit to modern elderly-care service?

The aging population has been being an unavoidable social problem world-widely and due to the lack of labors for elderly-care services in most areas, modern ICT approaches are the most acceptable, cost effective and only way to support elderly-care services.

3. How to identify a successful ICT enabled business model for China elderly-care industry?

There are different key roles in the elderly-care eco-system. The successful elderly-care business model should satisfy most interests of the roles.

a) The elderly and family.

The elderly and family are looking for kind of service to fulfill the requirements of elderly's healthy and daily security. For example while a falling accident happened, an

emergency response should be made to save the elderly. Meanwhile, building up new connection between them for the mental needs is important. The elderly would like to have more communications with young generation so not to feel alone and the family prefers to keep updating real–time information from the elderly people. Besides, the service should not cost too much so to be an economic burden for the family in long term.

b) The service vendors

The successful business model should create more customers and opportunities to the service vendors within lower promotion costs rather than other traditional business models. It should provide more efficient distribution channels for the vendors and better quality control system.

c) The public sectors

The government has the strongest motivation to find a feasible ICT enabled business model as soon as possible due to its public responsibility. And in different cities, the local governmental sectors are even more interested in that topic which could be closely relevant to their political achievement. So for the public sectors, they will not consider the economic return in short term but lower social costs in longer term.

d) The platform operator

The platform operator is responsible for coordinating all other roles to cooperate on the same platform. Its vision is to expand the scale of business as large as possible. The larger number of participators is, the more value the business will be.

Actually, the ICT enabled elderly-care business model is still an edge developing research area especially in China market. There are not mature and systematical theory to support the research strongly. But in present, some practices combined with real estate business or small piloting projects have been carried out to explore the feasible approaches to create a successful business model for elderly-care services. The study has used empirical findings to show that the current cases may not make the anticipated impact. The arguments for this justification suggest the need for business modeling review which will enable it acceptable for more populations in different classes afforded by private or public sectors.

The scale of this research is therefore extensive and multifaceted even at a more specified level. To generate achievable methods with regards to the feasible business model, there is need for more case studies at the specified roles and markets. Exploring the following as future research strategies can facilitate the attainment of this goal:

a) Most of the elderly's demands are mental oriented, what kind of service could best support elderly's mental requirements could be an interesting topic to help identify the elderly-care business model.
b) Even if in the same country, people living in different areas may behave differently. To study the differences and customize the local business model would be significant.
c) Another key topic in the elderly-care business is to coordinate different service vendors to play on the same platform, a research to identify the systematical rules to manage the different vendors would be extremely important for the future work.

Although the study has been initialed by an international academic and commercial combined program, and was conducted in a practical piloting case in China, as a direct consequence of this methodology, the study encountered a number of limitations, which need to be considered.

The aging problem is a common challenge for the society, but it is also a great opportunity to innovate new business under the modern ICT support, which could create thousands of working positions and wealthy. The business modeling study in this paper was partly verified by the practical case study and it will be significant and worthy to implement more comprehensive studies on the topic until a systematical result could be derived.

References

[1]. Agarwal, R., Bills, J. E., Hecht, T. J., & Light, R. P. (2011). Role of Home Blood Pressure Monitoring in Overcoming Therapeutic Inertia and Improving Hypertension Control A Systematic Review and Meta-Analysis. *Hypertension*, *57*(1), 29-38.

[2]Alam, M. R., Reaz, M. B. I., & Ali, M. A. M. (2012). A review of smart homes—Past, present, and future. *Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on*, *42*(6), 1190-1203.

[3]Alaoui, M., & Lewkowicz, M. (2013). A living lab approach to involve elderly in the design of smart TV applications offering communication services. In *Online Communities and Social Computing* (pp. 325-334). Springer Berlin Heidelberg.

[4]Alexander, B. H., Rivara, F. P., & Wolf, M. E. (1992). The cost and frequency of hospitalization for fall-related injuries in older adults. *American journal of public health*, *82*(7), 1020-1023.

[5]Alwan, M., Rajendran, P. J., Kell, S., Mack, D., Dalal, S., Wolfe, M., & Felder, R. (2006, April). A smart and passive floor-vibration based fall detector for elderly. In *Information and Communication Technologies, 2006. ICTTA'06. 2nd* (Vol. 1, pp. 1003-1007). IEEE.

[6]Al-Faisal, W. (2006). Falls Prevention for Older Persons. *Eastern Mediterranean Regional Review online at www. who. int/ageing/projects/EMRO. pdf*.

[7]An, X. (2013). The approaches to prevent Chinese elderly people lost in outdoors. s老年人走失家人要防患于未然. *中国老年*, 33-34. (In Chinese).

[8]Aoyagi, Y., & Shephard, R. J. (2011). A model to estimate the potential for a physical activity-induced reduction in healthcare costs for the elderly, based on pedometer/accelerometer data from the Nakanojo Study. *Sports Medicine*, *41*(9), 695-708.

[9]AuthorHouse. Schäfer, W., Kroneman, M., Boerma, W., van den Berg, M., Westert, G., Devillé, W., & van Ginneken, E. (2010). The Netherlands: health system review. *Health systems in transition*, *12*(1), xxvii-1.

[10]Bierhoff, I., et al. (2013). Smart Home Environment. *Towards an Inclusive Future*. COST219 Project.

[11]Bin Li, Z., Yin Ho, S., Man Chan, W., Sang Ho, K., Pik Li, M., Leung, G. M., & Hing Lam, T. (2004). Obesity and depressive symptoms in Chinese elderly. *International journal of geriatric psychiatry*, *19*(1), 68-74.

[12]Calvo-Palomino, R., de las Heras-Quirós, P., Santos-Cadenas, J. A., Román-López, R., & Izquierdo-Cortázar, D. (2009). Outdoors monitoring of elderly people assisted by compass, GPS and mobile social network. In *Distributed Computing, Artificial Intelligence, Bioinformatics, Soft Computing, and Ambient Assisted Living* (pp. 808-811). Springer Berlin Heidelberg.

[13]Carter, S. E., CAMPBELL, E. M., SANSON-FISHER, R. W., REDMAN, S., & GILLESPIE, W. J. (1997). Environmental hazards in the homes of older people. *Age and ageing*, *26*(3), 195-202.

[14]Chang, C. L., Hsu, T. Y., Lin, F. L., Huang, C. D., & Huang, I. T. (2011). Leisure Activities for the Elderly–The Influence of Visual Working Memory on Mahjong and Its Video Game Version. In *HCI International 2011–Posters' Extended Abstracts* (pp. 358-362). Springer Berlin Heidelberg.

[15]Chang, J. H., & Liao, Y. S. (2012). Design Principles of Digital Game Interface for Elders. *International Proceedings of Economics Development and Research*, 15-19.

[16]Chen, J. (2007). Rapid urbanization in China: A real challenge to soil protection and food security. *Catena*, *69*(1), 1-15.

[17]Chen, S., & Jian, X. (2007). Research on Disaster Prevention of the Small-Scaled long-term care nursing home for the Elderly. *高齡化社會防災救助問題研究*, 7-11.(In Chinese).

[18]Chi, I., & Chou, K. L. (2001). Social support and depression among elderly Chinese people in Hong Kong. *International Journal of Aging and Human Development*, *52*(3), 231-252.

[19]Chou, K. L., & Chi, I. (2000). Comparison between elderly Chinese living alone and those living with others. *Journal of Gerontological Social Work*, *33*(4), 51-66.

[20]Chu, L. W., Chi, I., & Chiu, A. Y. (2005). Incidence and predictors of falls in the Chinese elderly. *Ann Acad Med Singapore*, *34*(1), 60-72.

[21]Chu, L. W., Chiu, A. Y., & Chi, I. (2006). Impact of falls on the balance, gait, and activities of daily living functioning in community-dwelling Chinese older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *61*(4), 399-404.

[22]Davis, A. J., Martinson, I., Gan, L. C., Jin, Q., Liang, Y. H., Davis, D. B., & Lin, J. Y. (1995). Home care for the urban chronically ill elderly in the People's Republic of China. *The International Journal of Aging and Human Development*, *41*(4), 345-358.

[23]El-Bendary, N., Tan, Q., Pivot, F. C., & Lam, A. (2013). Fall detection and prevention for the elderly: A review of trends and challenges. *International Journal on Smart Sensing and Intelligent Systems*, *6*(3), 1230-1266.

[24]Etzioni, D. A., Liu, J. H., Maggard, M. A., & Ko, C. Y. (2003). The aging population and its impact on the surgery workforce. Annals of surgery,238(2), 170.

[25]Hao, Y., Liu, X., & Deng, S. (2007). Risk assessment scale testing on falls in Chinese elderly people. 老年人跌倒风险评估量表的测试研究. *护理研究*, 21(20). (In Chinese)

[26]Hevner, A., & Chatterjee, S. (2010). *Design research in information systems: theory and practice* (Vol. 22). Springer.

[27]He, J., Gu, D., Wu, X., Reynolds, K., Duan, X., Yao, C., & Whelton, P. K. (2005). Major causes of death among men and women in China. *New England Journal of Medicine*, *353*(11), 1124-1134.

[28]Hinch, S. W. (2013). *Outdoor navigation with GPS*. Wilderness press.

[29]Huang, T. T. (2005). Home environmental hazards among community-dwelling elderly in Taiwan. *Journal of Nursing Research*, *13*(1), 49-57.

[30]Huo, H., Xu, Y., Yan, H., Mubeen, S., & Zhang, H. (2009, June). An elderly health care system using wireless sensor networks at home. In *Sensor Technologies and Applications, 2009. SENSORCOMM'09. Third International Conference on* (pp. 158-163). IEEE.

[31]Huffman, T. L. (2013). *Never Change*.

[32]Hu, H., Li, Z., Yan, J., Wang, X., Xiao, H., Duan, J., & Zheng, L. (2007). Anthropometric measurement of the Chinese elderly living in the Beijing area. *International Journal of Industrial Ergonomics*, *37*(4), 303-311.

[33]Jin, F. (2004). Welfare Analysis of China's Pension Reform. Economic Research Journal, 2, 55-63.

[34]Ke, C., & Pan, X. (2013). The solutions for rescuing a missing Chinese elderly people.救助走失老人. *全国商情*, 7. (In Chinese).

[35]Kempen, G. I., Steverink, N., Ormel, J., & Deeg, D. J. (1996). The assessment of ADL among frail elderly in an interview survey: self-report versus performance-based tests and determinants of discrepancies. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *51*(5), P254-P260.

[36]Kong, K. S. W., Lee, F. K., Mackenzie, A. E., & Lee, D. T. (2002). Psychosocial consequences of falling: the perspective of older Hong Kong Chinese who had experienced recent falls. *Journal of advanced nursing*, *37*(3), 234-242.

[37]Kortelainen, J. M., van Gils, M., & Parkka, J. (2012). Multichannel bed pressure sensor for sleep monitoring. *Computing in Cardiology (CinC), 2012*, 313-316.

[38]Kwon, O., Shim, J. M., & Lim, G. (2012). Single activity sensor-based ensemble analysis for health monitoring of solitary elderly people. *Expert Systems with Applications*, *39*(5), 5774-5783.

[39]Logan, J. R., Bian, F., & Bian, Y. (1998). Tradition and change in the urban Chinese family: The case of living arrangements. *Social Forces*, *76*(3), 851-882.

[40]Lubitz, J., Cai, L., Kramarow, E., & Lentzner, H. (2003). Health, life expectancy, and health care spending among the elderly. *New England Journal of Medicine*, *349*(11), 1048-1055.

[41]Luo, J., Zhu, G., Zhao, Q., Guo, Q., Meng, H., Hong, Z., & Ding, D. (2013). Prevalence and risk factors of poor sleep quality among Chinese elderly in an urban community: results from the Shanghai aging study. *PloS one*, *8*(11), e81261.

[42]Luo, Y., & Waite, L. J. (2014). Loneliness and Mortality Among Older Adults in China. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, gbu007.

[43]Lutolf, R. (1992, November). Smart home concept and the integration of energy meters into a home based system. In *Metering Apparatus and Tariffs for Electricity Supply, 1992., Seventh International Conference on* (pp. 277-278). IET.

[44]Mace, N. L., & Rabins, P. V. (2011). *The 36-hour day: A family guide to caring for people who have Alzheimer disease, related dementias, and memory loss*. JHU Press.

[45]Mao, D. H., He, Z. L., He, X. G., Peng, P., & Xia, W. S. (2009). Review and prospect of research on flood risk analysis at home and abroad (Ⅰ): status quo of research on risk analysis of flood hazard [J]. *Journal of Natural Disasters*, *1*, 021.

[46]Meng , L., Yu, P., Li, X., & Wang, J. (2013). The Chinese Health Elderly Standards (2013),中国健康老年人标准(2013). *中国老年医学杂志*, *32*(8). (In Chinese).

[47]Newman, J. M., & Ludman, E. K. (1984). Chinese elderly: Food habits and beliefs. *Journal of Nutrition for the Elderly*, *4*(2), 3-14.

[48]Pan, S., & Jordan-Marsh, M. (2010). Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. *Computers in human behavior*, *26*(5), 1111-1119.

[49]Portet, F., Vacher, M., Golanski, C., Roux, C., & Meillon, B. (2013). Design and evaluation of a smart home voice interface for the elderly: acceptability and objection aspects. *Personal and Ubiquitous Computing*, *17*(1), 127-144.

[50]Raad, M. W., & Yang, L. T. (2009). A ubiquitous smart home for elderly. *Information Systems Frontiers*, *11*(5), 529-536.

[51]Roka, P. K. (2011). *U.S. Patent No. 7,983,718*. Washington, DC: U.S. Patent and Trademark Office.

[52]Ronald, C.P., Ronald, G.T., Micheal, G., et al. (2005). Vitamin E and Donepezil for the Treatment of Mild Cognitive Impairment. *N Engl J Med*, 352 (2005), pp. 2379–2388.

[53]Ruiz, I. M., Ramos, J. P. L., & Ramón, A. A. (2013). Remote health care system for elderly people with chronic diseases. *Ariadna*, 39.

[54]Schrier, R. W., Estacio, R. O., Esler, A., & Mehler, P. (2002). Effects of aggressive blood pressure control in normotensive type 2 diabetic patients on albuminuria, retinopathy and strokes. *Kidney international*, *61*(3), 1086-1097.

[55]Schooling, C. M., Lam, T. H., Li, Z. B., Ho, S. Y., Chan, W. M., Ho, K. S., & Leung, G. M. (2006). Obesity, physical activity, and mortality in a prospective Chinese elderly cohort. *Archives of Internal Medicine*, *166*(14), 1498-1504.

[56]Sichuan news. (2014, February 1). Decryption Changhong Intelligent Home. Retrieved from http://wenku.baidu.com/view/8006143931126edb6f1a101c.html?re=view (In Chinese).

[57]Sun, J. E., & Wang, H. (2012). The Research on the Development Path of the Industry of Chinese Long-Term Care of the Elderly [J]. *Journal of Social Science of Hunan Normal University*, *2*, 002.

[58]Teno, J., Kiel, D. P., & Mor, V. (1990). Multiple stumbles: a risk factor for falls in community-dwelling elderly. A prospective study. *Journal of the American Geriatrics Society*, *38*(12), 1321-1325.

[59]Trinh, V. Q., Chung, G. S., & Kim, H. C. (2012). Improving the Elder's Quality of Life with Smart Television Based Services. *World of Academy of Science, Engineering and Technology*, *67*, 572-575.

[60]Vaishnavi, V., & Kuechler, W. (2004). Design research in information systems.

[61]Wang, H., & Fan, W. (1997). Progress and problems of fire protection in China. *Fire Safety Journal*, *28*(3), 191-205.

[62]Wang, T., & Zhu, Z. S. (2010). Design and Realization of the Housekeeping Software Frame. *Journal of System Simulation,* S1.

[63]Whiz, S. (n.d.). (2012). Will China Grow Old Before It Becomes Rich? A Demographic Time Bomb, Part 1.Seeking Alpha. Retrieved October 16, 2014, from http://seekingalpha.com/article/644161-will-china-grow-old-before-it-becomes-rich-a-demographic-time-bomb-part-1

[64]Alexander Osterwalder, Yves Pigneur. Business Model Generation, June 13,2010, Wiley press.